CARE OF ARCHIVAL MATERIALS



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CARE OF ARCHIVAL MATERIALS

by

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PUBLISHER'S PREFACE

Preservation and Conservation of rare Materials including manusrcipts are vital to protect our knowledge treasure. Hundreds of years old materials with rare contact are to be protected / conserved to show case to the future generation and to the rest of the world for the inherent benefits they carry. Towards this direction Thanjavur Maharaja Serfoji's Sarasvati Mahal Library is taking Various steps.

Recorded informations on various materials starting from Inscriptions to Floppy disks are called Records of Archival materials. It is more important to preserve a record than to create the record. The place for storage of records is called Archives. This book entitled 'Care of Archival Materials' deals with the care and conservation of manuscripts, books, maps etc.,

All forms of direct or indirect action aimed at increasing the life expectancy of an undamaged and or damaged element of cultural property is termed as Conservation. Preventive conservation, Curative conservation and Restoration are the three stages of conservation and every archival material need its own way of conservation according to the degree of damage caused by various factors. Natural and human factors are responsible for the deterioration of an archival material. These damages can be controlled by proper handling and

planning. Disseminating the knowledge of conservation to the human society is the only way for preserving the cultural property of any country. This book will serve that purpose and the people who are handling the archival materials will largely be benefitted. Dr. V.Jeyaraj, the Curator of Government Museum (Retd.), Chennai has accomplished the task of writing this book by his painstaking efforts. I thank the Editor for his good job.

I am thankful to Government for sanctioning funds for publishing the book.

I thank the Administrative Officer, Thiru M.Sankaranarayanan, B.A., Dr. S.Sudarshan, M.A., B.Lit., M.L.I.S., Ph.D., and Library staff for having taken sincere efforts to bring out the reprint.

This book willbe very much usefull to the research scholars and the students.

Dr. N.SUBBAIYAN, I.A.S.,
District Collector and Director,
Sarasvati Mahal Library.

Thanjavur
20.12.2014

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CHAPTER 1

INTRODUCTION

History of Archives:

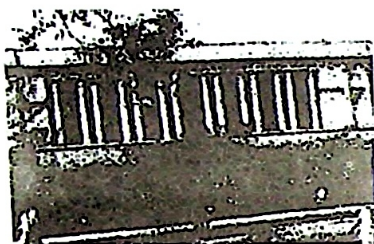
Document is a record, which consists of information regarding administration, trade, etc. In the earlier days records were maintained in various ways.

From time immemorial terracotta (Babylonians), papyrus (Egyptians clay moulds (Harappans), bronze, bone, silk, wooden planks (Chinese) wooden planks (Osinians), palm leaves (south east Asians, Indians) had been used traditionally as the base for writing and the records were preserved. *Bhoj patthar* was used in the northern parts of India for writing purposes. Even today the barks of a particular tree is being used for writing purposes. Stone inscription is also a type of record available throughout the world. India especially Tamil Nadu is not an exception to this. In the later days paper is found much useful for making records.

Archives are institutions where records of the past and the present are preserved for posterity. The archives are of various types. The governments for the benefit of the people in the past established mostly the archives.

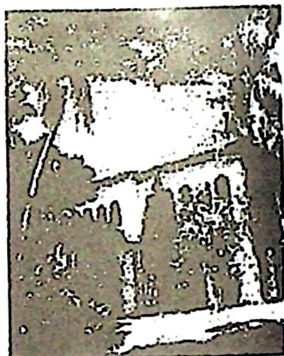
Museum is a non-profit making permanent institution in the services of the society and of its development and open to the public, which acquires, conserves, researches, communicates and exhibits for purposes of material evidence of man and his enjoyment.

Athenians preserved their documents in the temple of the Mother goddess around 5th and 4th Century BC. Roman Emperor Justinian (527-565AD) made arrangements for the construction of a building, an officer to be appointed to preserve them so that the records might not be damaged in the future. But,



National Archives of India, New Delhi

on 12th September 1796 as per the laws of the New French Government organised the archives in Paris to preserve the records of the Revolutionary Government. Later it was made as the French National Archives in 1796. In 1838, Public Records Office was established at London in England. In 1934, in USA, the National Archives was established. In the Indian context the Imperial Records Office was established at New Delhi in 1891. Today, it functions as National Archives of India. In 1942, this Archives set up a Conservation Laboratory to take up research in the conservation of records. In 1919, Mr.J.A.Chopman, the Librarian of the Calcutta National Library got a Conservation Laboratory, which got facilities to preserve books. Even before our independence there were many archives in our country. The best among them is the archives at Chennai. It was established in 1909 and the preservation of manuscripts is regularly carried out. To day it is called the Tamil Nadu Archives and historical Research, Chennai. It conducts regularly a course for the benefit of the government staff in the maintenance of records.

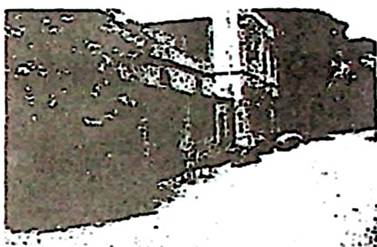


Tamil Nadu Archives, Chennai

The Thanjavur Maharaja Serfoji Saraswathi Mahal Library also has got all conservation facilities. Theosophical Society, Oriental Manuscripts Library at Chennai, Arobindo Ashram, Pondicherry, International Institute of Tamil Studies,

C.P.R.Art Foundation, Institute of Asian Studies at Chennai etc., are showing much interest in the preservation of archival materials.

The Chemical Conservation and Research Laboratory of the Government Museum, Chennai, started in 1930 is doing both conservation and research activities related to archival materials besides conservation of all types of antiquities. It conducts conservation training programmes in various Conservation activities. In 1997 the Curator of the Chemical Conservation and Research Laboratory conducted a one-week programme for the officials of the Archives on the care of archival materials.



Chemical Conservation and Research Laboratory, Chennai.

The sources of the cultural property are varied. Objects may come through exploration, excavation, treasure-trove finds, through purchase, transfer, gift etc. Records reach the archives by the transfer of the records from the Government. The Archives are the storing place of the archival records. Once the objects were taken care off by their own environment/owners; when they are brought to the archives or museums, a very few members of staff manage a large number of objects. The aggression due to nature and human beings is high. In order to control the deterioration of the cultural property,

1. We must be aware of the factors of deterioration or dangers.
2. The archival or museum personnel should be competent to handle the problems and
3. The conservators-restorers and the archival or museum staff should be aware of the latest techniques of conservation and restoration

Conservation Techniques:

The various conservation techniques of the archival materials are:

1. Curative Conservation
2. Preventive Conservation
3. Restoration

1. Preventive Conservation:

All forms of indirect actions aimed at increasing the life expectancy of (an) undamaged and or damaged element(s) of cultural property are termed as preventive conservation.

All the collection in a museum are sound, stable and some are damaged. What ever may be the condition of the objects, preventive conservation is essential. A team of people in a museum may do this.

2. Curative Conservation:

All forms of direct actions aimed at increasing the life expectancy of (an) undamaged and or damaged element(s) of cultural property are termed as curative conservation.

In a museum about 2% of the collection may be in need of Curative Conservation. When a unique piece is actively damaged, it needs curative conservation. It is an urgent and vital process to be carried out by a trained conservator/restorer.

3. Restoration:

All forms of direct actions aimed at enhancing the message(s) carried out by (an) damaged element(s) of cultural property are termed as restoration.

About 10% of the objects in the collection of a museum are in a damaged condition. The priority of the treatment is secondary. A trained conservator-restorer may do restoration. Some objects are in need of only conservation. Some objects are

only in need of restoration. There are objects, which are in need of conservation and restoration.

The message from an object (or record) should be communicated to the onlookers and also they should be protected.

The archivists, librarians or the curators are all not much aware of the damaging factors of the objects. There are very few cases, where objects are miraculously protected without the help of any direct or indirect action. If the conservators discuss the problems with the archivists, librarians or curators most of the objects will be better preserved.

In order to increase the life of an object, one must know the life history of the object. The physical integrity of the object is 100% at the time of its creation. The time taken to completely disintegrate is called the life expectancy. For example an iron object at the time of its making has 100% physical integrity. When it completely corrodes, there is no metal core but the form of the object is maintained. Even though there is deterioration, the life expectancy may be increased further by conservation measures.

The history of an object, which comes as a treasure-trove or excavated object, at the time of accidental finding or excavation it is found under a deteriorated condition. By the application of preservative measures, the life expectancy may be improved, reduced or will reduce at the rate at which it originally deteriorates.

Aggressions of Cultural Property:

The aggressions or the deteriorating factors of an object can be natural or man made. They may be by the environment, building and staff. The natural aggressions may lead to immediate destruction or progressive destruction.

Immediate Destruction:

Immediate destruction to the cultural property may be brought about overnight by flood, fire, earthquake etc.

Progressive Destruction:

Progressive destruction is also a natural one. This is brought about by environmental pollution due to air, dust, moisture, heat, light, micro organisms, wind, salt and intrinsic factors like chemical changes with in the material, physical changes etc. The man made aggressions are classified as public aggression and professional aggressions.

Public Aggression:

The public aggression is mostly due to unawareness. They are such as vandalism, tearing of leaves from books or manuscripts, encroachment of a declared monument or site, more tourism attraction, theft, war and terrorism, urbanisation, misusing the cultural property.

Professional Aggression:

The aggression due to the professional mishandling of the archival materials, antiquities and cultural objects is called professional aggression. This is due to the lack of awareness, planning, training, security, control and improper execution of curative conservation, restoration or, transport, storage, exhibition, support, lighting, handling, maintenance etc.

Strategy for Conservation:

For better conservation of the cultural property, a systematic strategy is to be adopted. There are seven steps for the conservation measures to be taken. They are:

1. ***Know*** your collection
2. ***Categorise*** and ***identify*** the aggressors
3. ***Avoid*** the aggressors
4. ***Block*** the aggressors
5. ***Check*** or ***monitor*** the aggressors

6. ***React*** against the aggressors
7. ***Communicate.***

The preventive conservation measures may be taken on the above lines.

Preventive Measures:

The archivist, librarian or the curator in consultation with the conserv tion scientist must determine the degree to which a collection is to be handled and the stack or display area and storage arrangement must be made available to the demands made upon it.

1. Correct levels of heat and humidity by air conditioning; Improvised microclimate through good building, designing etc.
2. Well planned storage areas with proper display materials.
3. Protection from light: correct levels of light; UV cutting films, window blinds and curtains.
4. Use of proper conservation techniques and materials for housing the materials.
5. Full instructions to those connected with the collections such as proper maintenance, upkeep, usage etc.
6. Correct handling, no smoking, no pens or inks.
7. Clean surface for avoiding deterioration.
8. Cleanliness of the environment
9. Use of facsimiles instead of the original materials where ever necessary.
10. After the office hours the mains should be switched off.
11. Water and drainpipes should not be laid in the rooms where stacks are located.
12. Cross ventilation should be provided in the libraries and archives.
13. Sun breakers or rain shades should be provided for windows to avoid direct sunlight and rain entering into the hall.

14. It is advisable to have one fire extinguisher per every 10 metres of length.
15. It is better to have good architecture of the building to house the archival materials.

CHAPTER 2

RECORDS ON BARKS

Historical Background:

Birch bark was commonly used in the earlier days for writing records. It was bark of birch tree. Birch bark was used in India from early times. The earliest birch bark manuscript known so far belongs to 2nd or 3rd Century AD. The bhoja trees grow at a height of 14,000 feet in the Himalayas. King Bhoja understood the use of barks of bhoja trees for records keeping in the 17th Century. During the Mughal Emperor Akbar the use of paper replaced the use of birch bark and palm leaves. In India it was used as *bhoja-patra*, which is supposed to be a very sacred writing material in India. Birch-bark was in extensive use in the northern India especially in Jammu and Kashmir and other hilly areas. Even today *bhoja-patras* are available in the houses as the houses in Tamil Nadu has the palm-leaf manuscripts. Government Museum, Chennai is having few samples of Bhoja patra and are preserved.



A Bound Volume of Bhoj Patras

Birch-bark Manuscripts:

Birch-bark is composed of several thin layers of sheets as that of paper. Each layer is naturally adhered by gum as well as knots. When separated it will be like a tissue paper. It is brown in colour. Organic solvents will be able to dissolve the gum. The bark contains about 40% of cellulose. Salts of salicylic acid are

also present. It contains about 10% of lignin, which is an unwanted compound as far as the preservation of birch-bark is concerned.

Birch-bark was prepared for writing as follows:

The peeled off bark was dried and applied with oil and polished so that it is suitable for writing. The inner portion of the bark is used for writing. It is cut into shape, holes were made in the centre to run the cords to hold the leaves together and tied after protecting them between two wooden covers like that of palm-leaf bundles. The ink used for writing on the birch-bark was carbon ink. Writings were done with pen and ink. In case of scratching the letters with sharp writing tools thick barks were used as such.

Deterioration of Birch–bark Manuscripts:

Birch-bark is multi-layered. Because of the high humidity adhesive property of the natural gum,. which binds the layers the birch-bark disintegrates. Because of low humidity the flexibility of the birch-bark is lost. Due to age the birch-bark becomes stiff and brittle. Excessive moisture makes the sheets stick to each other. The separation of the stuck sheets will be very difficult. Due to the presence of the insect repellent natural compounds in the birch-bark even at high humidity insects and fungi do not grow.

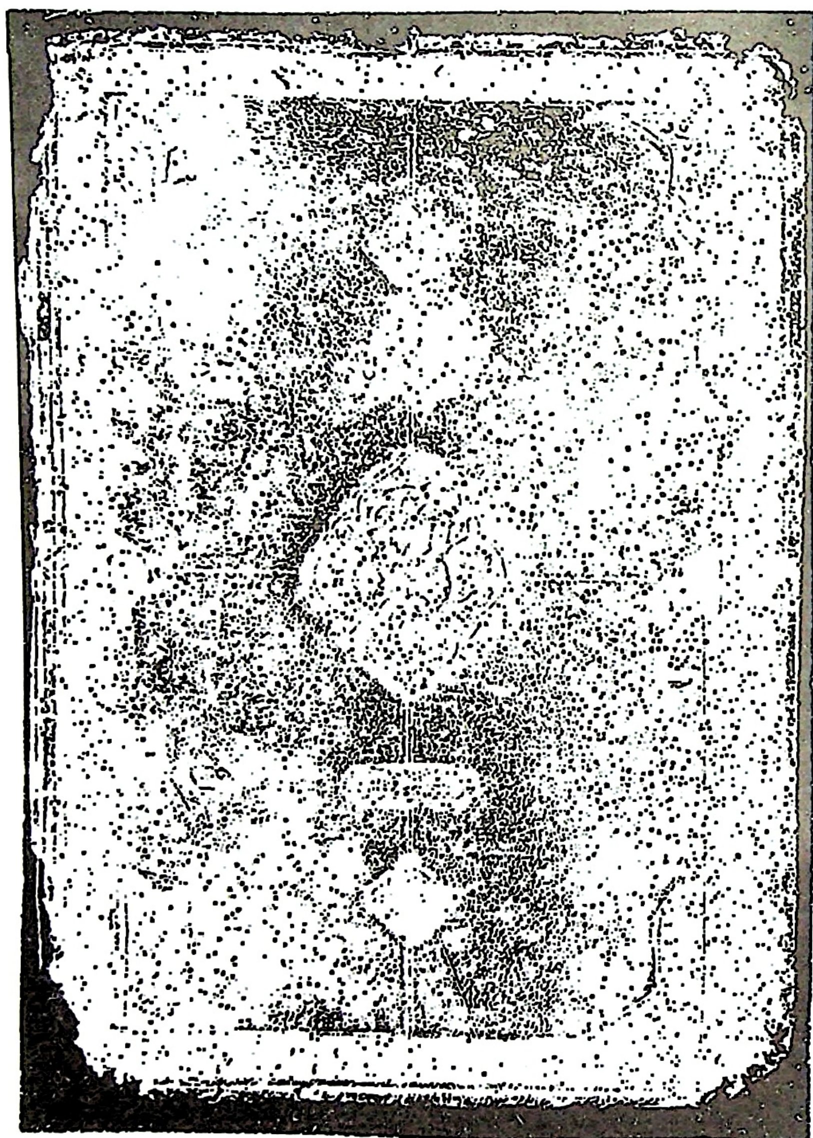


A Separated Birch-bark

Conservation of Birch-bark Manuscripts:

Since organic solvents will dissolve the natural gum present in the birch-bark, only water should be sparingly used to remove

dirt and other stains very carefully with out affecting the writings. It becomes very brittle in the dry condition. But it can be relaxed by moisture without affecting the writings. A tightly wrapped wad of writings on birch bark was found inside a Buddhist image of the 18th Century. It was possible to unwrap it, and to recover eleven legible documents from the wad. Majumdar was successful in separating the blocked birch bark leaves by the exposure of the leaves to steam. Even though the layers are disintegrated the nodes keep the layers together. Unless the layers are completely separated no attempt should be made to separate them. In such cases the separated layers may be fixed together with tamarind paste. The separated edges can be treated with paste with the help of a fine hairbrush. The damaged edges may be repaired with the help of paper. If the birch-bark manuscript is totally disintegrated, then it should be reinforced with transparent cellulose acetate foil. But this cannot be an ideal way as the cellulose acetate foil binds only the outer layer. Encapsulation can be done. Since the edges are very easily damaged it is always better to cover the birch-bark manuscripts with the help of two planks larger in size than the manuscripts. In order to avoid frequent handling of these manuscripts, they may be kept in almyrahs, which are airtight where insect repellents or fungicides can be kept to avoid insects and fungi.



Insect affected leather binding

CHAPTER 3

PARCHMENT AND LEATHER MANUSCRIPTS

Historical Background of Leather Based Materials:

Parchment and leather were used in the ancient times especially in the mediaeval Europe and Western Asia for writing purposes. The famous Ur excavation revealed bundles of written parchment and they were released out of folding and the details were deciphered. In the museums and archives the leather-based objects are available either in the form of art objects or records.

Leather Processing:

Leather is nothing but cured skin, which is de-haired, de-fatted, and made non-putrient and impervious to water. Skin is a net work of protein fibres chiefly *collagen*. Unless cured, moulds and bacteria destroy the raw skin. Tanning is a method of finishing skins to produce leather. Tanning can be done traditionally by using the essence from the barks of certain trees or by minerals like salts of chromium, which render leather impervious to water while preserving its flexibility. Semi-tanned leather is produced by stretching the skin from which flesh etc., have been removed and then rubbing on it, an oil or a fat emulsion. The skin becomes soft and flexible by this and then it is smoked. Semi tanned leather is used to make costumes, pouches, headgears etc.

The parchment is nothing but the flesh side of the skin, which is processed. Parchment is made out of the skins of small animals such as sheep, goat, antelope, deer, etc. The parchment prepared out of the skin of calf is called as *vellum*. The split skin or the parchment is stretched on a frame and scraped down with a crescent shaped knife on both the sides. When it is being dried the skin is tightened and scraping is continued. The parchment is

treated with hot water, scraped again and while still wet, rubbed with pumice stone on both the sides. The parchment is dried on the stretcher frame. Parchment is translucent and is used in puppetry and for writing purposes. In order to use the parchment for writing purposes it should be bleached and the grease should be removed by lime wash. The flesh side is preferred for writing. The transparency may be obtained by chemical treatment.

Deterioration of Skin Based Materials:

Museums have many leather based objects in their possession. Parchment records are also preserved in the museums. Archives have large volumes of books, which are leather bound. Since the leather-based objects are organic in nature, they very easily deteriorated. High humidity affects leather based materials as the moisture increases the water content of the leather and facilitates the growth of micro organisms such as insects, pests, fungi. As parchment is hygroscopic in nature it gives off moisture and become dry at a dry climate.

Brittleness or *hardening* is another defect in these types of materials. When parchment loses its water content or in other words when the leather is dehydrated it gets hardened and distorts in shape. Slight mechanical stress will make it to break.

Dust accumulation creates a lot of problems by becoming dirt, which not only obscures the details on it but also deteriorates the leather-based materials. Pollutants like oxides of sulfur, carbon and nitrogen dissolve in the moisture present in the atmosphere and increase the acidity in leather and parchment.

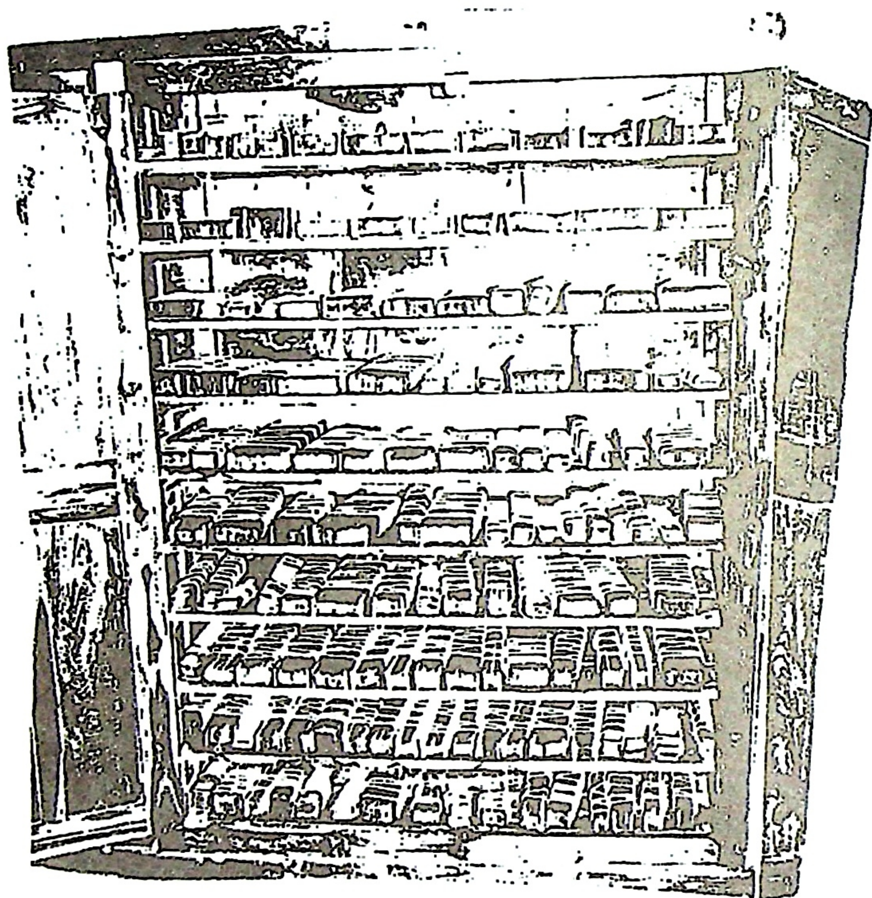
Parchment comprises of fibrous protein *collagen.* Collagen is a polymer of different amino acids. Collagen breaks down into smaller units by hydrolysis to give gelatine and the conversion is rapid at higher temperature and relative humidity

and the pH is greater than 6.5. Parchment is alkaline and there fore it becomes yellowish. It is hygroscopic in nature and there fore gets hydrolysed in excess of moisture. As it dries the skin tightens considerably and the deformation of the membrane results in the loss of ground as well as writing ink..Being organic in nature, parchment manuscripts are attacked by fungi and insects.

Conservation Measures:

As leather and parchment are organic in nature it is always better to maintain the relative humidity and temperature at optimum levels. In order to protect them from fungal attack, leather and parchment materials should be periodically fumigated with thymol. In order to protect them from insects, fungicides and insecticides may be used.

Hardened leather based materials should be made flexible by the application of leather dressing materials. The parchment should be applied with 2% castor oil in rectified spirit and rubbed. The excess of castor oil may be removed by rectified spirit. In case the letters are soluble in rectified spirit, proper solvent for the castor oil such as acetone, methanol should be chosen. Distortion should be removed by the application of 5% water in rectified spirit and the area is flattened and then treated for flexibility by 2% castor oil in rectified spirit.



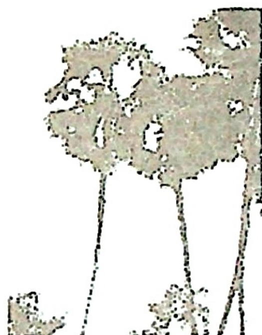
Storage of palm leaf manuscripts

CHAPTER 4

PALM LEAF MANUSCRIPTS

Historical Background of Palm-leaf Manuscripts:

Man in the past has chosen palm-leaf as one of the materials for writing and keeping records. The use of palm-leaves was in vogue in almost all South and Southeast Asian Countries. Even though the use of the palm-leaves is very old, the use of the palm-leaves came into practice some time in 6th Century BC. The earliest availability of palm-leaf manuscripts in Nepal was from 7th Century AD. Palm trees are in plenty in Indian sub-continent and in Southeast Asia. It has been mentioned that *palmyra* tree was brought to India from Africa. Roughly 4000 species of palms are existing all over the world. Among them two varieties were chosen to write. They are the *palmyra* palm (Borassus flabellifera Linn) which is called as *tala* and fan palm (Corypha umbracufera Linn) which is otherwise called as *sritala* or *talipot*. The *palmyra* grows to a height of 15 to 20 metres. The leaves are thick and coarse and are suitable for incision with a stylus. The *talipot* palm is taller and grows up to a height of 20 to 25 metres. The leaves are thin and flexible and light coloured. In this case writing is done with carbon ink. The palm leaves used for writing are about 40 cm to about 1 metre long and 5cm



Palmyra Tree

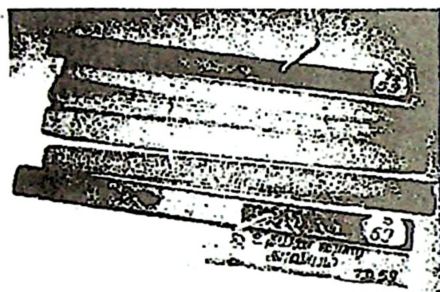


Palmyra Palm Leaf

to 8cm wide. The bundle thickness sometimes will be around 50 cms.

Preparation of Palm-leaf Manuscripts:

There are various methods of preparation of the palm-leaf manuscripts in different parts of the world. The tender leaves of 4 to 5 weeks old are cut and dried under shade for a week and buried under marshy water for about 3 months and cut into size and used for writing. The other method is to boil the dried leaves in turmeric solution and cut into required size. In the case of ***tala*** the writing is done with the stylus. The incised portions are filled with lampblack mixed with gingely oil. In some other places the incised portions were rubbed with the leaves of *kadukkai* plant (Terminalia chebula) or green leaves of *kovakkai* plant (Coccinea grandis). The incised portions after some time get black colour making the letters legible. In case of the ***sritala*** leaves only writing is done with ink or paint. After the writing is done, the palm-leaves are kept in position by punching two holes at both sides of the leaves. A red coloured linen or cotton cord then passes through the leaves. Two planks are kept on both the sides and the planks are tied with the help of the cord. The planks are sometimes painted. Cotton cloth dipped in turmeric solution and dried is used to cover the bundle. The bundles are kept together and are covered with a red cloth. The red cloth is a good repellent for the insects. Covering the palm-leaves protects the palm-leaves from dust and it provides a microclimate with in the bundle.



Well Preserved Painted Palm-leaf Bundle

Traditional Methods of Preservation:

Traditionally palm-leaf manuscripts thus prepared were preserved in the loft of the kitchen, probably to drive away the insects and fungi from palm-leaf manuscripts. These bundles were used to be taken out of the storage on the *Vijayadasami* day, cleaned and kept back. I have been told by many in the villages during my collection tours that throwing them into rivers, wells or tanks ost many thousands of palm-leaf bundles. If at any time dampened by rain, they used to be dried under shade. The annual ritual also involved applying either a paste of coconut leaf juice (Coccinia Indica the) and wood charcoal or with turmeric. This is to make the palm leaves to be insect proof. Some times the palm-leaf manuscripts were kept in the rays of the rising sun or the setting sun possibly for destroying the traces of the growth of insects and microorganisms. When stored along with the bundles of the manuscript pieces of *vasambu* or dried *ginger* was also kept with the manuscripts to protect them from insects. *Neem* leaves (Azadirachta Indica) were also kept with the manuscripts to protect them against insects and such *neem* leaves are to be renewed whenever required. I have seen palm-leaf manuscript bundles were applied with turmeric powder.

Traditional keeping of the palm-leaf manuscripts in the kitchen lofts made them free from the fungi and insects. More over herbal insect repellents such as sweet fig i.e.*ghora* bark (Acorus Calamus) was also used to prevent the insect attack.

The Physical and Chemical Characteristics of Palm-leaves:

The durability of the palm-leaf manuscripts depends on the physical and chemical characteristics. The leaves of the *tala* variety are coarse and thick and therefore liable for brittleness than the *sritala* variety. Chemically speaking, the palm leaves are made up of cellulose, resins, oils and materials like lignin. Even though the cellulose fibres are very strong it can be broken

up by the action of oxygen and ultra violet radiation from sunlight. If the oil content of the palm-leaves is lost, the palm-leaves will become brittle. The palm leaves are being organic in nature insects attack them very easily.

Causes of Deterioration:

Palm-leaves are organic in nature and therefore they are vulnerable to biological deterioration. An unfavourable environment will be unfavourable for the upkeep of the palm-leaf manuscripts. In order to save the palm-leaves one must know the various deteriorating factors or aggressions. They are mainly affected by natural and man made agencies.

Atmospheric Factors:

Atmosphere is one of the agencies, which contains most of the deteriorating elements. The various acidic oxides present in the atmosphere are absorbed by the palm-leaves when required moisture is available in the palm-leaf manuscripts and there by the acidity of the palm-leaves are increased. The intrinsic factor of the palm-leaf manuscripts is also responsible for the increase in their acidity. Oxygen of the atmosphere breaks the cellulose of the palm-leaves and they become brittle. The moisture in the atmosphere increases the moisture content of the palm-eaves and chemical change takesplace in the palm-leaf manuscripts. It is always better to maintain the relative humidity at 45 to 55%. The temperature is yet another factor, which affects the palm-leaves. Th ideal temperature for the good upkeep of the palm-leaves is between 20 and 22°C. If moisture is more, then the palm-leaves will be stuck together.

Biological Factors:

In the damp condition the biological agents like insects and fungi flourish very well and damage the manuscripts. Some of the insects (bookworm) tunnel through the bundles by eating the leaves. Some groups of termites cause very great damage to

the palm-lcaf manus cripts if favourable climate is present. Fungi grow very well on palm-leaves when condition suitable for their gro vth exists. They eat away palm-leaves and damage them very seriously. Because of the tunneling of the palm-leaves by the insects the leaves stuck together and it is very difficult to separate them. Gastrallus Indicus (Bookworm) are the dangerous enemy of palm-leaf manuscripts.



Insect Attacked Palm-leaf Manuscript

Physical Damages:

Palm-leaf manuscripts become dry if they are not cared for a long time. They wrinkle and the edges are damaged and crumble at the edges. Careless physical handling also damages the palm-leaves. Improper storage creates a lot of problems to the palm-leaf manuscripts and their deterioration is faster. Even neglect will make them unusable.

Stains and Change of Colour:

Due to aging the palm-leaf manuscripts get brown colour. Constant use also makes them to take up brown colour. Due to the accumulation of dust and the action of fungi on the edges they appear black in colour. Stains are formed quite often due to the excreta of flies and mosquitoes. This will be visible as small black dots. Dead insects also sometimes develop stain on the manuscripts when the leaves hold the dead insects in between. Unless removed these stains will be embedded into the leaves.

Dust:

Dust is yet another danger to the palm-leaf manuscripts. Prolonged neglect and poor storage would result in the accumulation of dust on manuscripts. If the dust is not removed it will become dirt mixed with water and will become the food for the microorganisms. The dirt will make the palm-leaves unreadable.

Defacing of the Writings:

Due to the constant use or due the biological activity the palm-leaves loose the clarity of the writing and are not readable. The carbon paste used normally gets detached from the leaves and falls down in due course and the writings are not readable.

Preventive Measures:

Prevention is better than cure. Strategies of the preventive conservation should be taken into account. The type of the collection should be known very well for those who are in charge of the collection. The enemies must be identified and categorised. In the case of entry of the enemies, they should be avoided by providing suitable environment. Even after providing suitable environment for the cultural property, if there is defect, the enemy may be blocked from attack. They should be regularly checked and monitored. When the enemies of archival materials are entering into the records, one should react immediately to get rid off them. The message should be communicated to all the concerned and suitable conservation measures be taken.

Physical Examination of Manuscripts:

What ever may be the condition of the palm-leaves it is very essential to examine the condition of the palm-leaves to give suitable conservation treatment. The number of manuscript leaves in a bundle should be noted down. The condition of the manuscript should be recorded to proceed further. The

dimensions, previous treatment given, the provenance, reference to the photographs taken, previous publication, proposed treatment etc., should be recorded.

Conservation of Palm-leaf Manuscripts:

We can not generalise the type of treatment to all the palm-leaf manuscripts as the treatment differs from one to the other depending upon the condition of the manuscripts and defects found in them. The strategy towards the conservation is very important. Like preventive conservation, conservation of the manuscripts is also very urgent one. Some times only one treatment may be necessary. In some other cases many measures are to be taken. The restoration is not so urgent. The conservation of the manuscripts is urgent and it depends only on the condition of the manuscripts.

Cleaning:

Cleaning of the palm-leaf manuscript is an important prerequisite for all subsequent procedures of treatment to be exercised. Cleaning should be done before any chemical treatment. Otherwise the dust and dirt will create problems in the conservation procedure. The physical cleaning can be done with a squirrel hairbrush to remove the loose dust and adherent solid materials. The dirt, which is hard to remove by brushing, should be removed by moistened cotton swab. This can also be done away with a dampened cloth. If it is difficult to remove, then along with water a little *teepol* may be added. If the condition of the palm-leaf manuscript is good, then the manuscript may be dipped in water and all dirt and dust may be removed. In case they are weak, then organic solvents such as acetone, benzene, rectified spirit should be used to remove the dirt and other excreta of the insects and fungal deposits. Whenever water is used it should be seen that the water should be dried carefully to avoid wrinkling of the manuscripts. Glycerine in water (1:10) is

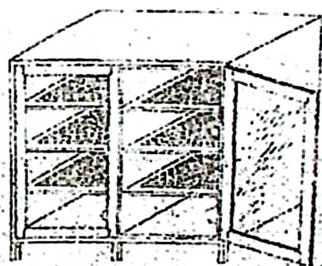
used to remove the dirt. If found weak, glycerin in rectified spirit may be used. Some times there will be a deposition of soot on the manuscripts. It should be removed with the help of rectified spirit. If the manuscript is painted care should be taken when solvents are used. Before using the solvent it should be tested in an inconspicuous corner for the fastness of the pigment. Organic solvents such as ethanol (rectified spirit), acetone, carbon tetra chloride, methanol, methylated spirit, toluene, petroleum ether, benzene, pyridine, tri chloro methane may be used. Hydrogen peroxide is also used in case the stains are persisting.

De-acidification:

Some times the palm leaves are brownish in colour masking the details. In such cases it is better to remove the brown colour to have a better look and legibility to read. Unless the acidity from the palm-leaves is removed, the palm leaves will become brittle. Before any attempt is made for the de-acidification the leaves should be numbered. In case the leaf is broken all the pieces should be given the same number. The palm-leaf manuscripts may be either dry de-acidified as in the case of paper with ammonia or wet de-acidified. For wet de-acidification of manuscripts written with water-resistant inks, use of calcium and magnesium bicarbonate solution is encouraging. Both dipping and spraying can be done. A 5-10% solution of glycerin will be useful in this process as it adds strength to the palm leaves while washing. When palm leaves are containing water soluble inks, barium hydroxide in organic solvents such as acetone, methanol, ethanol, or magnesium hydroxide in methanol or magnesium acetate in ethanol may be used to remove the acidity. This may be done either by spraying or dipping.

Fumigation:

Fumigation is a very important activity in archives, libraries or museums where palm leaves are preserved. It is better to fumigate palm leaves when they are entering into the archives or museum. Since the palm leaves are organic in nature, microorganisms very easily affect them. It is there fore good to fumigate them before any conservation treatment is provided. There are various chemicals used to fumigate the palm-leaf manuscripts depending upon the type of insects or fungi. An airtight fumigation chamber with perforated shelves and glass fitted doors and an arrangement in the centre of the bottom most plank for heating chemicals like thymol crystals with the help of a 40-watts bulb could be used equally for fumigating manuscripts against insects and fungi as in the case of paper manuscripts. Para di chloro benzene is a very good insect repellent. A mixture of carbon tetra chloride and trichloro ethane is effective against the insects. This mixture should be kept on the top shelf of the fumigation chamber, as the misture is heavier than air Naphthalene bricks may be kept in the racks. It is better to fumigate the palm leaves periodically to avoid both insects and fungi.



Fumigation Chamber

Separation of Stuck Leaves:

Palm-leaf manuscripts at times are found stuck together. This is called blocking of manuscripts. There are many reasons for this. The palm leaves might have been wet due to rain or due to very high humidity. Some times this happens due to the worms tunneling the bundles. It is very difficult to separate the leaves in such cases. It is better to get training in the

preservation of palm-leaf manuscripts and start doing the job or it may be entrusted to a skilled conservator. Anyhow, in such cases it is better to consult a conservator. If the stuck or blocked manuscripts are kept in a humidifier in a RH of around 85-90% the leaves get softened and they can be separated using a scalpel or paper cutter very carefully and patiently. Exposing the manuscripts to steam for moistening and loosening the leaves can also do this. No effort should be made to dip the manuscript in water. In case there is no alternative the bundle may be dipped in hot water containing 5-10% of glycerin. The separated leaves should be dried between blotting papers. Only after the separation of leaves they should be subjected to cleaning etc.

Relaxing Flexibility to the Palm-leaves:

The major defect of the palm-leaf manuscripts is hardening. The leaves become dry and any act of bending will result in breakage. There fore the flexibility should be introduced into the leaves by the use of chemicals or natural materials. Many have tried different chemicals for regaining the flexibility to the palm leaves. The following are some of the methods of relaxing the palm leaves:

1. The hardened palm leaves are cleaned with glycerin and water and then treated with camphor oil, citronella oil, lemon grass oil or walnut oil. This improves the flexibility of the palm leaves.
2. Hardened palm leaves are treated with the fresh extract of the green palm leaves with alcohol. This has been observed that brittle palm leaves get flexibility when they are treated with a mixture of palm-leaf extract, clove oil, black pepper oil and sandal wood oil.
3. Vegetable oils such as camphor oil, eucalyptus oil, neem oil, citronella oil, lemon grass oil etc., are very effective in softening the embrittled palm-leaf manuscripts. Besides these,

poly ethylene glycol 200 has been found effective in relaxing th hardened palm-leaf manuscripts.

Conservation of paintings on palm leaves is rather difficul as the pigment on the palm-leaves is not bound strongly with th palm leaves. In the case of paintings on palm leaves many leave: are joined together with the help of tying with thread.

Mending the Broken Palm-leaf Manuscripts:

Sometimes the palm-leaf manuscripts are found broke and it is very urgent that the broken pieces should be joined There are many methods of doing so. The broken edges ar cleaned with acetone and pasted with methyl methacrylate o poly vinyl acetate in acetone. Sometimes the joints are repairec with the help of tissue paper and a suitable adhesive. If th portions are missing, similar unwritten palm-leaves are take and kept below the broken palm-leaf and along the edges of the old leaf a sharp knife is run through so that the new leaf is alsc cut according to the shape of the broken edge of the old leaf. The new cut leaf is fixed in position and mended with the help of poly vinyl acetate in acetone.

Filling up the Holes:

Insect attacked holes are found on the palm-leaves The existence of the holes mars the look of the palm-leaf manuscripts. Mulberry tissue paper is ground well with methyl cellulose as a paste. The affected palm-leaf is placed on a glass plate and the mulberry tissue paper paste is taken in a sharp spatula and the holes are filled with the paste. The repaired leaf is placed in between two tissue papers and kept under a glass plate. If the holes are larger in size, then the unused palm-leaf is cut into shape and applied with an adhesive at the edges and fixed in position. Poly vinyl acetate or methyl methacrylate adhesive may be used in this case.

Re-inking the Incised Matter:

Due to aging the palm-leaf manuscripts loose the writing. In the case of *tala* leaves it is easy to re-ink the letters incised. But in the case of the *sritala* leaves it is difficult to write. In the case of *tala* leaves the incised portions may be re-inked by rubbing with lamp black mixed with oil. Excess lamp black is removed with a cotton cloth and further cleaning is done either with alcohol or an alcohol-glycerine mixture (1:1). In the Maharaja Serfoji Saraswathi Mahal Library, Tanjore the palm leaves are swabbed with a mixture of citronella oil and lamp black in rectified spirit. The excess paste is cleaned with cotton. By this the leaves get flexibility and the letters are legible. Citronella oil is very much useful. Some conservators prefer lemon grass oil instead of citronella oil.

Reinforcement Techniques:

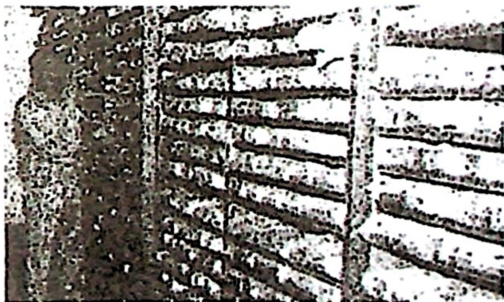
After the palm-leaf manuscripts are mended and the writings are re-inked if the palm-leaf manuscripts are very weak, they should be laminated in order to give the reinforcement to the manuscripts. There are various modern methods of lamination. Older methods are also under practice in the archives. Many modern methods of lamination have come into practice in most of the archives and libraries. Cellulose acetate foil of thickness 0.0223 m.m. is used for lamination. The cellulose acetate foil should be flexible, semi moisture proof, free from nitrate, should have stable plasticizer and should not change its colour.

Chiffon Repair:

This process is useful for *tala* manuscripts written with stylus having water-soluble carbon ink writing. The palm-leaf manuscript after all repair and re-inking should be kept on an oil paper or butter paper and the chiffon cloth little bigger than the manuscript is kept on the leaf and carboxy methyl methacrylate

the room to take away regularly the stagnant air from the room.

3. Access of direct sunlight into the storeroom should be avoided as it has a deleterious effect on the palm-leaves.
4. The palm-leaves may be bundled and wrapped in a red coloured cloth and the bundles may be kept individually in an almyrah with suitable clearance between shelves or shallow drawers of a cupboard.
5. The storage should be so designed that when a particular bundle is retrieved the other bundles should never be disturbed.
6. The rare manuscripts may be kept in side boxes designed for keeping different sized palm-leaf manuscripts.
7. In the case of cartons or bundles there should be provision for writing details of the manuscript, its title, its language, its size, its catalogue number etc.
8. The cupboard or the almyrah, in which the manuscripts are kept, should at least have a clearance of 15 cms from the floor at the bottom. Suitable metal or plastic cups, which have provision for keeping insecticides or oil, may be kept under the legs of the almyrah.
9. Insect repellents like naphthalene bricks or para dichloro benzene may be kept along with the bundles.
10. Regular cleaning of the room to get rid off the dust is essential. A vacuum cleaner may be used for removing dust from the room. Periodical dusting of



Stacking of Palm-leaf Manuscripts

the manuscripts is also desirable. It is better to cover the bundles with plastic covers, which are provided with some holes for the entry of air.

CHAPTER 5

PAPER AND BOOK MATERIALS

History of Paper

Paper is the word derived from a Greek word ' *Papyrus* '. Papyrus is the name of a plant, which was found on the marshy lands along the river 'Nile' in Egypt. Its botanical name is Cyprus Papyrus Linn. Papyrus for writing purpose was prepared by removing the skin of the plant, arranged in order, pressed and dried under sun. There are references available to prove the use of papyrus is 3500 BC. Barks were also brought into use around 170 BC as a writing base material.

Paper was invented by T'sai Lun, a Chinese Public Works Minister in 105 AD. Mulberry stalk, bark, hemp, rags etc., were made as pulp, mixed with an adhesive, filtered and then made as paper. There is proof for the use of paper in China around 200 BC. Paper manufacture was later spread to Korea, Japan, Central-eastern countries, and Western countries. In India paper was manufactured using baggasee, grass and jute and from plants growing in marshy lands. The paper prepared out of baggasee is also called as tree free paper. By this method the trees are not disturbed and the ecology is maintained in the forest. Even though paper is manufactured mainly out of cellulose from trees tree free paper manufacture is now given importance by the Government paper industries as this avoids the cutting of trees.

The paper prepared out of wood pulp as such cannot be used for writing. In order to make the paper suitable for writing purposes the paper should be glazed by the application of glaze like flour, gelatine, resin, alum etc. In 1798, Nicholas Louis

invented the papermaking machine. By this machine paper pulp was sent between two rollers and given the desired thickness to paper followed by sending between two hot rollers, which were suitably heated thereby paper was dried and later rolled in a roller.

Characterisation of Paper:

Today paper has got a great role in reflecting the feelings of humanity and bringing news to others. Paper is the main base material of books, newspapers, journals, records etc. In the beginning, even though rags, grass, hay straw, cane etc., were used to make paper today 90% of the paper is manufactured from wood. Cellulose is the main content of wood up to 60-80%. The wood, which is used to make paper, contains 29% lignin, 43% cellulose, 27% other carbohydrates. Besides these lime, sodium silicate, sulphur, alum, resin, gelatine etc., are used in the manufacture of paper. The wood, which is used for the manufacture of paper, is crushed by machine and made as pulp with the help of chemicals.

Cellulose is required for paper but lignin, tannin, wax etc., present in wood affect paper. Whatever be the method of manufacture of wood pulp, the pulp contains lignin and other dyes. In order to remove the dyes the pulp is bleached with the help of chemical bleaches. Glazing is done to make the paper suitable for writing. The newsprint paper does not contain any glaze. Art paper contains very good glaze to increase the quality of painting.

Paper made out of linen and cotton rags is strong and durable. In this type of paper gelatine glaze is given for writing purposes. The paper made out of wood pulp and glazed using resin and alum for writing purpose is weak and less durable. There are many varieties of paper in between the above two varieties. News print paper is a very poor quality paper, which is

less durable. They become very easily acidic and crumble due to aging.

Characteristics of Inks:

Ink is nothing but a natural or artificial dye mixed with a liquid to form a liquid, paste or solid compound. At about 2500 BC, the Egyptians used carbon inks. The Chinese, Romans and Greeks followed it. A fine powder of carbon in oil made the very old carbon ink. It is durable as well as chemically non-reactive. The carbon soot obtained from lamps had been used along with oils in writing, painting and in incised palm-leaves to preserve them. The carbon ink had also been prepared by boiling carbon with resin from trees and water.

The iron gall inks were prepared out of the insects from oak trees or from tannin of some plants. From the ancient times these types of inks were prepared by different means. They appeared brown or dull in colour. These inks are permanent but they affect paper. Ferro gallo tannate is the blue black ink suggested for records. It should contain not less than 0.4 gm. of iron per 100 c.c. as per the specification for fluid ink in IS: 221-1962.

Printing Inks:

Printing inks are made by mixing a dye, resin and oil. Oil is used as carrier of the ink. Resin is used to fix the ink on paper. Black ink is prepared out of lamp black, yellow, green and orange inks from chromium salts, orange from molybdenum salt, red and yellow from cadmium salts, blue from iron salts and also from a plant, *Neeli* (Tractoris indigo-ferae). The pigment azurite and verdigris are green and are natural minerals.

Inks of today are all synthetic dyes dissolved in liquids. They are either soluble in water or alcohol. Ballpoint inks are prepared by dissolving the inks in oils. There is difficulty of adherence of these inks to paper. These inks are soluble in

alcohol. Permanent records are prepared out of iron gall inks, which contains iron.

Deterioration of Paper:

In general, the records are made out of paper, leather, cloth etc., which are of plant or animal kingdom. Therefore, they are perishable. There are many difficulties in their preservation. If their deterioration is known, their preservation can be done in a better way. The deterioration of paper is due to two factors. They are:

1. Intrinsic factors and
2. Environmental factors

Intrinsic Factors:

The deterioration of records depends on the quality of the raw materials out of which they are made. If the raw materials have short fibres the paper prepared out of them will be weak. If the chemicals used for the preparation of wood pulp are not removed completely, they will affect paper. The cellulose of the paper slowly changes chemically and are damaged. Due to the presence of lignin, paper gets brown colour and damaged. The iron impurities entered into paper during the manufacture in due course form brown spots and they are called *foxing*. There are other reasons also available for the formation of *foxing*.

Acidity:

Acidity is a property acquired by paper and allied materials due to aging. Acidity is acquired on paper in due course both internally and externally. The moisture along with the acidic gases is absorbed by the paper and the acidity of the paper is increased day by day. The fibres are broken into pieces due to chemical changes, and the strength of the paper deteriorates. The acidity of paper is measured by pH scale, which ranges from 1 to 14. A pH of 7 is neutral. If the pH is less than 7 it is acidic and above7 it is alkaline. Because of the

oxidation of lignin, paper becomes brown and ultimately gets brittle.

Environmental Factors:

The environment includes the weather, light, atmospheric gases, microorganisms, dust etc., which are present around the archival materials. According to Cameron places are polluted by atmospheric air, light, heat, humidity, vibration, parasites, insects, fungi, human beings, natural calamities, the damages to the control system which control heat and relative humidity.

Physical factors:

Light:

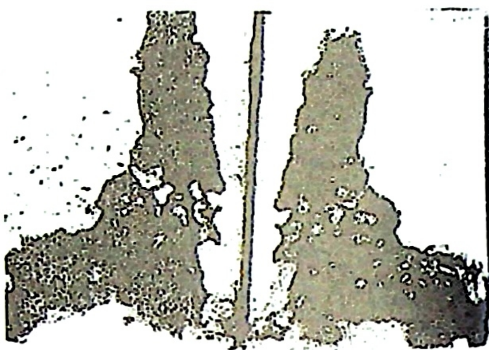
Whether natural light or artificial light, paper gets deteriorated either visibly or invisibly when it is exposed to light. *Browning* of paper is a visible change. But, damage to the fibres resulting in *embrittlement* is an invisible change. But, when they break we worry. This embrittlement is due to the action of UV light on the fibres. The long chains are broken and paper is damaged. The amount of damage depends on the following factors:

1. Intensity of light
1. Exposure time
3. Type of light
4. Absorbency of light

17-lux light is sufficient for visibility. We may allow 50-lux light where records or archival materials or other organic materials are preserved. We may use UV absorbing films where tube light is allowed. By using spectro radiometer the intensity of light, amount of UV light can be measured. By controlling the light the damage to the archival materials may be reduced. There fore it is needed to monitor the amount of UV light which falls on the archival materials.

Moisture:

The moisture in the atmosphere may be measured by using a hygrometer. The moisture is measured in terms of relative humidity. The humidity at a particular temperature of a particular volume is related to the saturated condition of humidity at the same temperature. It is expressed in percentage. The relative humidity is from 0 to 100%. When water is in gaseous state, it is highly absorbed and paper is highly damaged. Due to absorption of moisture, many defects are noticed on paper. Paper looses its strength and gloats; the ink or pigment gets weakened. Some kinds of paper especially art paper stuck together. The adhesive used in the record gets loosened and leaves are stuck together. This is called as *blocking* of paper. Oxides of sulphur, nitrogen, carbon etc., form acids with water. The acidity of paper is increased by the absorption of the acidic gases. The ideal relative humidity for paper records is 50 ± 5%. If the relative humidity is less than 45% the moisture from paper is removed and undesirable damages occur to paper besides cracking of adhesives.



Bookbinding Lost Due to Moisture

Heat:

Temperature is the measure of heat of a matter or place. Heat is measured in terms of temperature either in centigrade scale or Fahrenheit scale. Heat is transmitted either by conduction, convection or radiation. In air or liquid heat is conducted by conduction, and in case of vacuum heat is

transmitted by radiation. If the paper is exposed to excess heat or long-time in heat, it becomes brittle. They become yellowish then get blackened. Heat increases chemical change within paper. The suitable temperature for the good house keeping of the paper materials is 21± 2°C

Dust:

In the atmosphere two types of dust are found. In an undisturbed atmosphere dust settles and they are called particulate matter. Burning of materials and chemical reactions also create particles which are fine particulate. The particulate increases in number because of the burning of coal, fuels and by the plying of vehicles. Because of the settlement of the particles dust accumulates on the archival materials too. Dust becomes dirt due to moisture. The micro-organisms grow over them. Along with the dust smoke, carbon dust, ash, salts, calcium, ammonium sulphates, nitrates, chlorides, oxides, tar, fungal spores, bacteria etc., are found.

Chemicals:

In the atmosphere among the various constituents unwanted materials such as oxides of carbon, sulphur, nitrogen, hydrogen sulphides, and salts like chlorites, bromides, iodides, hydrocarbons, ammonia etc., are also present. Because of the reaction of the chemicals with the paper or the absorption of the chemicals by the moisture absorbed by the paper, the archival materials get affected. The lignin present in the paper gets oxidised and affects cellulose thereby paper gets deteriorated.

Acidity:

The stability of paper mainly depends on the raw materials of the paper. The acidity, acquired by the paper, damages paper and other archival materials. The acidity is acquired by the archival materials either by the action of the chemicals used for paper making or due to the chemical action

with the environment for many years. The dissolved acid fumes in moisture are absorbed and acidity is increased. Carbon-di-oxide forms carbonic acid, oxides of nitrogen form nitrous or nitric acids, oxides of sulphur form sulphurous or sulphuric acids and these acids are absorbed by paper and their acidity is increased. Because of the acidic contents of the locality and using acidic papers, cardboard and other materials, the archival materials acquire acidity. The acidity of a record can be inferred from the colour change to brown and also by an acidic smell emanating from the records. The acidity is measured by the pH scale. The pH is nothing but the hydrogen ion concentration in the material in the moist condition.

Measuring pH:

The pH can be measured by various means. The pH paper may be kept at an inconspicuous corner of the document after wetting the surface. From the colour change and comparing the colour with the pH paper colour chart, the pH of the paper can be found out. The pH of the paper may be found out from the washings of the paper by using pH meter, pH pen etc.

Other Defective Gases:

Various gases, which affect archival materials, are found in the atmosphere. Because of the burning of fuels in industries, houses, and vehicles many gases are emanated. Carbon monoxide, carbon di oxide, nitrogen oxides, ammonia, hydrogen sulphide, chlorides etc., are the most damaging gases. Because of the ultraviolet rays oxygen is converted into ozone. Ozone damages the bonds between carbon and hydrogen in the cellulose of paper and weakens the paper.

Removal of Gases

The gases, which affect paper, may be removed from the room by various means. The unwanted gases in a room may be

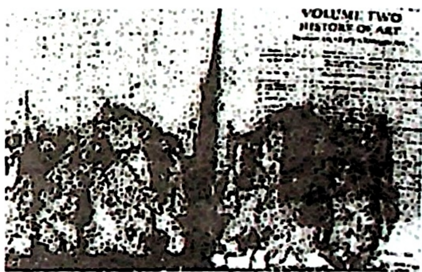
removed by dissolving them in water or adsorbing them in solid surfaces or chemically changing them. Therefore, when a room is to be air-conditioned the devices, which can remove the unwanted gases, should be fixed. By fixing carbon filters, sulphur oxides, ozone etc., may be filtered. Oxides of nitrogen, carbon etc , may be absorbed in water if air is sent through water. The chemical solutions used for absorbing the gases should be changed at regular intervals.

Dangers of Biological Agents:

In the tropical climate plants like fungi and moulds and animals like bacteria, insects and rodents affect the archival materials when they are moist and hot.

Fungi:

The fungal spores are present in the earth, water and air. They will be dormant at any environment. But, the spores sprout and grow when they have the required moisture and heat. They are found in different colours. Fungi grow in a relative humidity range of 63-100% and temperature range of 15-35°C. As certain fungi are responsible for certain decease to those who handle the affected archival materials, they should be carefully handled. Fungal attacked paper, archival materials appear black and are found to be weak.



Fungal Attacked Book

Insects:

Even though, there are thousands of insects, only certain insects badly damage the archival materials. They are silver fishs, cockroaches, book lice, bookworms, termites, beetles etc.



SilverFish

Silverfish:

Silverfish and similar insects are affecting materials in houses, museums, libraries, archives etc., which are located in the tropical climate. They do not have wings. Silver fish is normally about 10 cm long. They eat the surface of paper, resin and paste from bookbinding. Their life cycle is two to three years.

Class: Insecta, Order:













Class: Arachnida, Order:

Beetles:

These types of insects make noise. They affect the cloth used in binding and paper. There are many varieties of beetles. They live in dry and hot climate.

Bookworms:

Bookworms (Gastrallus Indicus) affect very much books and manuscripts. The larvae travel from the surface of the manuscript down to the bulk of the volumes and cause damage in the form of pinholes and this act is called *tunneling*.

Cockroaches:

Cockroaches multiply in the temperature range of 20-29°C. They affect paper and leather binding much. They eat the resin and adhesives used in bookbinding with a great liking for the paste.

Termites:

In the tropical climate the damages to the archival materials due to termites are much. They live in wood and also

is applied over the chiffon. Similar treatment is given to the other side and dried under shade and the edges are trimmed. This can be also done with chiffon and *maida* flour paste, which is mixed with an insecticide like formalin or copper sulphate, if the ink is insoluble in water. It is found that chiffon mending with *maida* flour paste is found to brittle in few years.

Chiffon Lamination:

Palm-leaf manuscripts having acetone insoluble writings may be reinforced by chiffon lamination with chiffon cloth and cellulose acetate foil with a solvent like acetone. In this method the cellulose acetate foil and the chiffon cloth are cut little larger than the leaf and the leaf is sandwiched by cellulose acetate foil and chiffon cloth at both the sides. Acetone taken in a cotton swab is rubbed over the chiffon. Acetone dissolves the cellulose acetate foil and the chiffon is fixed to the palm-leaf manuscript. This procedure is repeated with the other side and the extra chiffon cloth along with cellulose acetate foil is trimmed to the size.

Tissue Repair:

The palm-leaf manuscript is applied with carboxy methyl methacrylate and the tissue paper is spread over the palm-leaf and pressed carefully on the document. The other side is also done similarly and dried.

Tissue Lamination:

All palm-leaf manuscripts can be laminated irrespective of the type of ink with the help of special tissue paper provided with adhesive acrylic rubber. The special tissue paper is pressed on the leaf so that no air bubble is left inside.

Solvent Lamination:

Palm-leaf manuscript is sealed between sheets of cellulose acetate foil and tissue paper. Cellulose acetate foil and tissue paper on both the sides flank the palm-leaf. Acetone is

applied on the tissue paper, which dissolves the cellulose acetate foil and makes the tissue paper to be fixed to the manuscript. The same procedure is adapted to the other side also.

Heat Lamination:

In Tamil Nadu Archives, the library section is preserving the books by means of plastic sheet by melting them and fixing them to the manuscripts. This is not a reversible technique. There is some opinion among some of the archivists that it is better than the chiffon and maida flour paste mending. Instead of allowing the manuscripts to crumble they can preserve them some locally available methods. The letters are more legible than the documents laminated by chiffon mending.

Even though there are many reinforcement methods there is no universal reinforcement technique. Some times the reinforcement differs from leaf to leaf.

Stacking of Manuscripts:

The damaged palm-leaf manuscripts are conserved and restored by various means depending upon the type of damage and the manuscript. This is not the final duty of the archivist. There is a great task of preserving them for posterity. They should be properly stored and available for reference. They should be properly documented. Index cards may be prepared or they may be computer documented.

1. For proper care of the palm-leaf manuscripts the temperature and relative humidity of the hall in which the palm-leaf manuscripts are stored should be controlled. The temperature may be between 21±2°C and the relative humidity may be 50 ± 5%. The Oriental Manuscripts Library, Chennai had been recently air-conditioned.
2. The storeroom should have air circulation. Exhaust fans should be fitted in the room or openings should be made in

under earth. They are called as dry wood termites and subterranean termites. Within a night they destroy organic materials like books and other archival materials.


Termite Attacked Book

Book lice are insects, which are small in size. Some live on materials drawn from biological origin. They eat away books, photographs, watercolour paintings and paper. They also eat the resin or paste used in binding.

Rodents:

There are different types of rodents. Among them mice and rats are common. They destroy generally books, archival materials and leather or cloth portions. They destroy the above in the context of searching their food. Their excreta also give a damaging effect when they have contact with the surface of the archival materials.

Accidents:

Archival materials greatly get destroyed because of natural calamity. Flood, fire, cyclones, earth tremors etc., include calamity. The wrong handling also results in accidents. The ignorance of handling also brings forth accidents. Crowded storage, improper storage etc., results in many accidents to the archival materials.

Flood:

Due to heavy rain and because of the leakage and seepage water may damage archival materials. Sometimes flood also may enter such buildings because of heavy rains and breach of dams etc. When fire extinguishers are used to extinguish fire, or water pipe lines are damaged archival materials are seriously damaged. Art papers stuck together and blocked and the

separation of such stuck papers becomes very difficult. When flood or water affects the archival materials, they should be dried by proper ventilation, fumigated and damaged materials should be restored. Stagnant air should be exhausted and fresh heated air should be circulated. Dehumidifying the room helps in the removal of moisture. Keeping all the windows open and providing fan helps to have a dry climate. A spray of 10% thymol in methanol may be sprayed on archival materials. Highly water affected archival materials may be subjected to freeze drying at -20°to –30° C and the water present in the material reaches solid state and gets vaporised and therefore no water stains are formed

Fire:

In archives, libraries and museums there is a likely hood of fire as the contents are mostly organic in nature. Once fire starts, it is difficult to save those materials, which got fire. Because of the organic nature, archival materials get fire. The other causes of fire are electrical faults, smoking inside the buildings, using inflammable materials, carelessness etc.

Fire/ Smoke Detecting Devices:

It is very important to detect smoke or fire inside archives, libraries or museums in order to take immediate steps to stop spreading of fire. Now a days, many smoke/fire detecting devices are available, which can detect smoke/fire inside the buildings where such devices are installed, thereby fire will be detected and action taken to extinguish fire. Heat detectors, smoke detectors, fire detectors, laser fire detectors etc., are available today for this purposes. When fire starts in a building, automatic water sprinklers will start functioning in case they are installed. In European countries especially in the UK if there is no proper fire detection and fighting devices fixed. no permission is given for the establishment of such an

institution. The floors are also marked with red fluorescent paint giving the direction where the staff and public should go to the exit at an emergency. If there is any emergency exit the lock should be tested frequently and the availability of key should be known to all the staff who are working in the area.
next day of my arrival-regarding.

In the Indian context, it is right to mention here that the National Museum, New Delhi, the National Archives of India, etc. have got good fire fighting facilities. Even though all the archives, museums and libraries are provided with fire fighting equipment, their maintenance is not to the expected standard. It is better to check their working condition periodically so that they may be utilised at the time of emergency. All the staff should be trained in fire fighting.

Fire Extinction:

Fire may start in archives, libraries, museums etc., due to various reasons. If the reason for fire, type of fire, etc., is known it is easy to extinguish the fire. Therefore, it is rather very important to know the characteristics of fire. Fire needs ignition temperature, flammable material and a supporter of combustion i.e. oxygen. If all the three or at least one is cut off, then the fire automatically extinguishes.

Categories of Fire:

There are different types of fire extinguishers depending on the type of fire. The principle involved in a fire extinguisher is either to bring down the combustion temperature, to cut oxygen supply by making a cover around the combustible material or to remove the combustible material away from the fire.

Soda-acid fire extinguisher extinguishes the fire on combustible materials (type A) like the archival materials, which brings down the combustion temperature as well as producing



Impulse Type Fire Extinguisher

carbon di oxide, which is a non-supporter of combustion. Recently impulse fire extinguisher is available in which two cylinders containing water and air is useful to put out the fire by triggering the gun attached to it.

Foam type fire extinguisher is suitable for extinguishing the fire (type B) on the inflammable materials. It forms lather and covers the materials, which catch fire. The gas produced in this device is not good for health and therefore its use is not much advised. It is banned by the government. Dry chemical fire extinguisher is also good for extinguishing all types of fire. Soda acid fire extinguisher is suitable only for the type A fire and it should not be used for the fire due to electrical faults, as this will risk the user, as electricity will be conducted to the user through the water released from the extinguisher. Halon type fire extinguisher contains Bromo chloro difluoro methane. This is also not good for human health and hence its manufacture is banned and in about three years it will be totally banned.



Foam Type Fire Extinguisher



Soda Acid Fire Extinguisher

Dry Chemical Powder fire extinguisher is good for all the fire except type A fire. This contains Sodium bicarbonate powder and it is pushed out with the help of carbondioxide stored inside. ABC powder Fire Extinguisher is good for all the three types of fire. This contains Mono ammonium phosphate powder and this powder is pushed out with the help of stored carbon di oxide. Therefore, it is highly essential to provide the fire extinguishers, which can extinguish all types of fire in archives, libraries, museums etc. When the fire extinguishers are fixed, it does not mean that the materials will not catch fire or in case of fire, fire will be extinguished automatically. It is highly essential to teach about the working of the fire extinguishers and fire fighting methods to all those who are working in the archives, libraries, museums etc. There should be a fire alarm, as this will facilitate the evacuation of the staff and public to safety. It should be borne in mind that the fire fighting devices should be maintained very well and they should be checked for their workability quite often. The chemicals inside the fire extinguishers should be changed at proper times. The fire officer's advice should be sought often.

Preventive Measures:

In order to adhere to increase the life expectancy of the archival and such cultural materials various preventive measures should be taken into account. The preventive measures may be divided into three.

1. Conservation of the environment
2. Protection from fire, theft etc.,
3. Proper building and methods of stacking, arranging, storing etc.

Conservation Measures:

It is the primary duty of the staff to monitor the environmental conditions and provide good environment to the

materials in archives, libraries, museums etc. The environment is the atmosphere, heat, moisture, dust etc., around the material. A good environment is free from harmful materials and having ideal condition of temperature and relative humidity

Archival materials, books, museum objects etc., should be maintained in an ideal environment. Certain standards are fixed for the well maintenance of them. If the conditions are maintained, the objects will be preserved in a better way for longer time.

Relative Humidity = 50 ± 5%

Purity of atmosphere = 90-95% (Dust, Chemicals should be filtered)

Light level = Minimum of 50 lux

Heat = 21° ± 2°C.

Protection from Fire and Theft:

As fire destroys very easily archival materials, books, photographs etc., fire can be averted in archives, libraries, museums etc. by resorting into proper fire preventive methods. Smoking should be prohibited strictly inside the stack area or in the galleries.

1. Inflammable materials should not be stored inside the stacks. The inflammable chemicals should be kept separately in the laboratory that too away from hot plates etc.
2. The electrical defects and faults should be set right then and there. The electrical wires should be changed as per the norms prescribed by the electricity rules. After office hours the electrical mains should be switched off. If possible separate main switches may be provided for each stacks or room.
3. The buildings of archives, libraries, museums should not be linked with other buildings. The buildings for archives, libraries, museums etc., should be separate.

4. The waste and other materials like packaging materials should be kept separately away from archival materials.
5. Entries into the archives etc., should be checked for avoiding bombs, crackers and other harmful materials inside.
6. Under any circumstances inflammable materials should not be allowed inside the stacks etc. Open fire should never be used.
7. In case of fire, alarm should be raised.
8. The telephone number of the Fire Office should be clearly and visibly exhibited.
9. Location of fire extinguishers and hydrants should be indicated for easy access to them in the event of eruption of fire.
10. Location of emergency gate or door should be clearly indicated and the locks should be in working condition.

Structural Characteristics:

The buildings for archives, libraries, museums etc., should be designed in such a way that they are suitable for the protection of archival and library materials and museum objects. It is very important to choose the best architectural design and the suitable building materials. Cross ventilation facilitates air circulation. Sun breakers or rain shades should be provided for the windows. It is better to choose materials, which will not be damaged by insects. If there is any need to use wood, it is advisable to use well-seasoned wood, which has anti termite qualities or the wood should be chemically treated to avoid insects. The building should be well protected from insects at the time of construction. It should be kept in mind that growth of plants very near the buildings should be avoided as the roots will damage the building foundation and the branches will scratch the building as well as they may facilitate squirrels entering into the building through them. The entry of pigeons,

bats, squirrels, rats etc., should be avoided by blocking the entry points. Free entry of fresh air is good for both the staff and materials. Therefore the design should help in the free circulation of air even in the case of electricity failure. If a garden is maintained around the buildings, the plants will absorb dust and will help in maintaining the weather. It is always better to construct the buildings away from traffic. Near the roads tall and broad trees may be grown, which absorb not only dust and noise but also provide beauty to the campus. The construction of building in the east westerly direction will avoid direct sunlight to the buildings.

Chemical Conservation:

In the archival conservation there are five stages of conservation. They are:

1. Examination of the objects and their environment,
2. Preventive conservation,
3. Interventive conservation,
4. Restorative conservation and
5. Duplicative conservation.

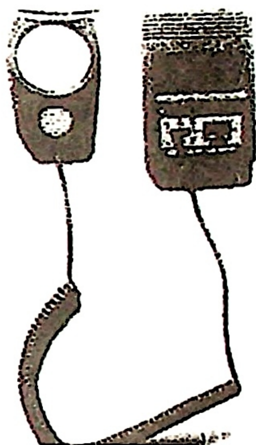
If examination of the situation is carefully done, proper preventive measures may be taken prior to the occurrence of defects and damages on the archival materials. In case the interventive measures are to be taken, the knowledge of the materials and the environmental conditions should be studied. When any restoration is found absolutely necessary, it can be done. The duplication of records is very good in case of archival materials.

Examination of Materials:

The examination of physical characteristics of the environment should be made regularly.

Light:

Light is a very damaging factor which causes deterioration to the cellulose materials. The pigments are discoloured. The chains of chemical compounds are badly damaged. Therefore, it is necessary to avoid light especially sunlight on the archival materials and library materials and other organic materials. Ultra violet light is a part of light, which damages archival materials. There fore, the windows may be provided with coloured curtains, which will avoid light as well as absorb ultra violet light. The UV light cutting films may be provided to the fluorescent tube lights. It should be noted that incandescent lamps are better than tube lights. Nowadays fibre optics is gaining importance, as they do not emit heat and harmful rays. The light intensity should be controlled inside the racks in the stacks and storage. 50-lux light level is sufficient for records. It is better to monitor the light level regularly. UV light monitor may also be used to monitor the UV light level.

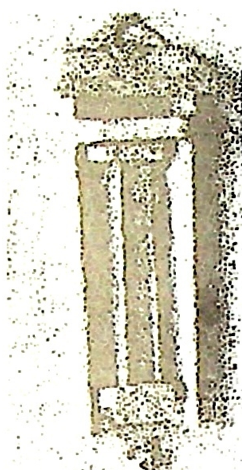


Lux Meter

Heat:

Heat is responsible for many damages in archival materials. Because of direct sunlight, lamps, and movement of large number of persons the temperature increases in a room. There are institutions where limited persons are allowed at a time. The temperature should be maintained at 21±2°C. If there is proper circulation of air the temperature is maintained. Because of heat, materials expand and contract depending upon

the environmental conditions. Because of this, book binding paste cracks, paper, leather, parchment etc., wrinkle. The temperature should be maintained at the ideal condition. Air-conditioning is the only way to maintain the temperature. But, round the clock air conditioning is costly and failure free electricity is also not ensured. Even if the air conditioners are provided there are difficulties to maintain the temperature in the rooms. It is essential to monitor the temperature round the clock to enable controlling the temperature. Any archives or library or museum must have the equipment such as thermometer, thermo hygrometer etc. Alarm systems are also available if there is breach of temperature level. If air conditioning is not possible for 24 hours it is better not to use it. There are certain institutions thinking of air conditioning their rooms only during working hours. It is dangerous, as frequent change of temperature will be created, which will damage the materials. It is better to have free flow of filtered air to avoid dust inside the stack room or gallery and reduce the temperature in the halls/rooms.



Maximum and Minimum Thermometer

There are two scales to measure the temperature. They are Centigrade and Fahrenheit. There is a conversion formula to convert Centigrade into Fahrenheit.

$°C \times 9 / 5 + 32 = °F$

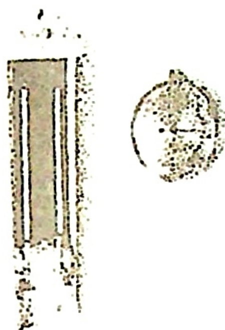
E.g. $30°C = 30 \times 9 / 5 + 32 = 86F$

The conversion formula to convert Fahrenheit to Centigrade is

$°F - 32 \times 5 / 9 = °C$

E.g. $86°F - 32 \times 5 / 9 = 30°C$

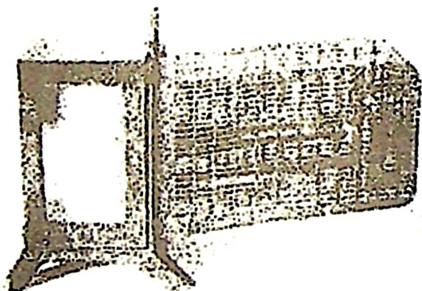
Relative Humidity:



Wet and Dry Bulb Hygrometer and Hair Hygrometer

Relative humidity is the measure of moisture in the atmosphere at a particular temperature compared to the saturated condition at the same temperature. It is measured in percentage. The relative humidity ranges from 0 - 100%. Lower the value drier is the condition, higher the value more humid is the condition. Higher relative humidity is unfavourable for the upkeep of archival materials. If the moisture content is more, the organic materials absorb moisture and expand. The ink may spread insects and fungal growth will damage them when high humidity exists. Because of the fluctuation in relative humidity the archival materials will expand and contract weakening the archival materials. If the windows are provided with curtains they will absorb moisture. If the racks are covered with cloth the effect of moisture can be reduced at the same time dust also will be avoided. In the summer if *cus-cus* made curtains are suspended outside the windows and kept wet, they will send cold air to the halls. Trays containing water may be kept in the corner, which will facilitate moisture in the room during summer. There are humidifiers, which will increase the moisture content to the required level. There are also dehumidifiers, which remove moisture by heating. These may be operated whenever necessary for which proper monitoring of relative humidity is highly essential. Air-conditioning the halls round the clock will help in maintaining the relative humidity. The ideal relative humidity is 50 ± 5%. There are various devices, which could measure the relative humidity. They are called hygrometers.

There are manual, recording and electronic devices to record the relative humidity. Alarm systems are also available in case the relative humidity breaches the set range. Whirling hygrometer, wet and dry bulb hygrometer can be kept at any archives or library or museum without much financial commitment. In this case both dry and wet bulb temperatures should be measured and the corresponding value of difference in the wet and dry bulb reading against the dry bulb reading in a given chart will give the relative humidity at the temperature. The hair hygrometer will give the direct relative humidity but it will not record the value. There are recording type of hygrometers, which will function for a weak. The relative humidity will be recorded round the clock for a week in the graph fixed to a drum, which rotates similar to the time clock. There are electronic devices available, which record relative humidity and the same is recorded. The monitors are fixed which will measure and indicate the relative humidity. If we fix all these equipment our duty is not over. But, we have to be very cautious to control the climate in the ideal condition. Archival materials affected by water may be dried under air circulation. Rare objects may be dried, in a box, keeping dried silica gel with indicator. Normally, the dry silica gel will be blue in colour. When it completely absorbs moisture, it will appear pink in colour. One square metre showcase may be in need of about 2 kg of silica gel. Heating may rejuvenate the silica gel. Trays with perforated sheets may be used for this purpose.



Thermohygrometer

Dust:

Dust is a very bad element of the atmosphere, which affects archival materials. Industrial areas and areas of very high vehicular traffic provide very high amount of dust in the atmosphere. Dust accumulates on the archival and other cultural materials. If not removed dust becomes dirt forming a part of the archival materials. Normally, floors are swept with brooms. It is not a good system of removing dust. Sweeping makes the dust to go up and settle on the materials. Only vacuum cleaning is the best method of removal of dust. Windows may be provided with dust filters. Exhaust fans also may be provided with necessary filters, which will not allow dust inside halls. When air-conditioning is done, we should provide proper dust filters, which will filter the dust to the maximum extent. Along with the dust bacteria, spores of fungi etc., are also removed. The chemical particles, ash, carbon, soot etc., got relieved. Some old buildings also contribute a great amount to dust. They should be repaired. New buildings should be allowed for seasoning at least for few months.

Gases:

Nitrogen is a harmless gas as far as paper conservation is concerned. Oxygen helps in the oxidation of the fibres in paper. The damaging gases in the atmosphere are chlorides, oxides of carbon, nitrogen and sulphur, hydrogen sulphide, hydrocarbons, etc. In most of the cases oxides of carbon, nitrogen and sulphur form the corresponding acids and are absorbed by the archival materials and the acidity of the archival materials is increased. Ultimately they are prone to damage. When air-conditioning is resorted to, provisions should be given to absorb the harmful gases and to send good pollution free air inside.

Control of Chemical Factors:

There are many means and ways by which the archival materials get acidified. Acidity gives brittleness and a bad smell to archival materials. The unwanted *'lignin'* in the raw material of paper gets decomposed and imparts acidity to paper. The absorption of acid fumes by paper also increases the acidity. Because of this, paper gets brown colour and also gets weakened. The affected paper materials cannot be brought back to their original condition by any means. But, the acidity can be removed. There are two methods of removal of acidity from the archival materials.

They are

1. Dry de-acidification or vapour de-acidification.
2. Wet de-acidification.

The first method is rather easy to handle as the archival materials may get de-acidified without any physical deformation. But, in the second case the records should be separated sheet by sheet and de-acidified by soaking them in chemical solutions.

Dry De-acidification:

Archival materials get brown colour due to acidity. A chemical, which is basic in nature, can remove this in the vapour phase. The basic chemicals like ammonia, amines etc., are kept in a cabinet in which the archival materials are kept. Ammonia vapour reacts with acidic chemicals in paper and neutral salts are formed thereby the acidity is removed. When the acidity is removed, it does not mean that the paper is strengthened. The strength of the paper can not be increased by this de-acidification. Sometimes amines are dissolved in acetone and the records are soaked in it to neutralise the acidic compounds in paper. Ammonia and cyclo hexylamine carbonate are used for de-acidification. The de-acidification should be done

periodically to remove the acidity. Dry de-acidification is good for the archival materials, as this will not disturb any soluble ink present in the archival material.

Wet De-acidification:

Limestone had been used in paper manufacture since early times. Sodium-bi-carbonate had been used to preserve materials made out of cellulose. Barrow in the middle of 1946 used a two staged de-acidification method for archival materials. In the first stage, the archival materials, which were affected by acids, were kept immersed in 0.15% solution of calcium hydroxide for 20 minutes. Then it was kept in 0.2% calcium bi carbonate solution for 20 minutes. Barrow was able to remove the acidity from documents by this method. This method is even today successfully followed in the Indian archives. By this method archival materials absorb moisture and if they are not properly handled they will get torn. Anyhow, this method is not suitable for those documents, which possess water-soluble inks in them.

If 1% barium hydroxide in methanol is sprayed on the document, which contain water soluble inks, the acidity of the document is removed. The excess salt settled on the surface acts as a reserve against the future absorption of acids. Use of magnesium methoxide and diethyl zinc separately in the stack room removes acidity from the archival materials in the stacks and storage. This is called the mass de-acidification.

Protection from Biological Agents:

In an ambient condition of temperature and relative humidity biological growth is facilitated on archival materials. In order to be free from the biological growth i.e. insects, worms, beetles, moulds, fungi etc., the archival materials should be kept in an ideal condition of temperature and relative

humidity. The help of some preventive chemicals may control the growth of the biological agencies.

Traditional Preventive Measures:

Colours have effect on insects. In the ancient times in order to avoid the insects, the documents were kept covered in red cloth. Turmeric powder (*Curcuma longa*) was also used to keep them from insects and fungi. Dry *neem* leaves, neem seed powder, tobacco, cus-cus, camphor, citronella oil etc., were used to preserve the archival materials. Neem (*Melia azadirachta*) consists mainly *nimbin* and *nimbiol*. These two chemicals present in the neem leaves are good repellents of various kinds of insects. Adathoda (*Adathoda zelyamica*), tobacco (*Nicotiana tobaccum*) and *thulasi* (*Ocimum bacillus*) were also used to preserve paper materials from the insects and fungi. Even today, Tanjore Maharaja Saraswathi Mahal Library continues to adopt an ancient method of prevention using herbal materials. The recipe is as follows:

Sweet fig (*Acorus calamus*)	1part
Black cumin (*Nigella sativa*)	1part
Bark of cinnamom (*Cinnamom* zeylancium)	1part
Pepper (*Piper nigrum*)	1/4part
Cloves (*Eugenia caryophyllus*)	1/4part
Camphor	a little

The powdered materials are kept in cloth sachets and kept along with bundles of archival materials and books. The archival materials are saved in this condition at least for six months. If the records are kept over neem leaf beds, which are dried under shade, they are safe. The bookworms are controlled by *sombu* powder. The powder made out of chincona bark is used to protect cloth from insects. It was a common practice to smoke rooms to eradicate insects and fungi with some chemical fumigants.

Fumigation:

Fumigation is a process of treating archival materials with chemicals in the vapour phase for about four to six days. By this the vapour penetrates into the leaves of the archival materials and the insects or fungi are either driven away or killed. When the archival materials are received after reference or used by scholars, they may be fumigated and then kept in their position. This avoids the biological infestation. Some of the household microbial agents that damage paper and other allied materials are - mildew, mould, fungus, silverfish, cockroach, whiteant, bookworm (Gastrallus Indicus). For complete eradication of bookworms, re-fumigation of the affected archival materials is necessary after 21 days as the eggs laid by bookworms hatch out after 21 days. The hatched out larvae should be eradicated. Whereas maintenance of neat and tidy storage and keeping optimum temperature and relative humidity helps in reducing susceptibility of damage by these agents, the precautionary measures are further reinforced by using insect repellent chemicals like naphthalene, camphor, or other preparations in the stacked or storage area. Use of insecticide solutions at places where these insects hid or breed e.g., walls, dark and dingy corners and below the shelves, keep a check on these insects.



Fumigation with Camphor

Insect infested materials need sterilisation with toxic fumigants in air tight fumigation chambers. Wooden as well as steel chambers are being used for fumigation with thymol and para dichloro benzene and mixture of ethylene dichloride and

carbon tetra chloride. In archives and libraries only these insecticides and fumigants find use, as they do not adversely affect the stability of archival materials. National Archives of India, New Delhi and Tamil Nadu Archives, Chennai have installed vacuum fumigation chambers in which ethylene oxide and carbon-di-oxide gases in the ratio 1:9 are sent into the chambers stored with archival materials under vacuum for 4 to 5 hours. Since the use of ethylene oxide is now banned only carbon-di-oxide is passed to drive of the biological agencies. Small archives and libraries may have a fumigation chamber to fumigate the archival materials. The fumigants will be suitable if they can be vaporised around the room temperature. The chemicals, which are used to eradicate biological growth, may be classified as follows:

1. Insecticides
2. Fungicides
3. General biocides

Insecticides:

The insecticides have the property of killing the insects. They include arsenic oxide, aldrin, dieldrin, lindane, pyrethrum, chloro pyriphos. But aldrin, dieldrin, pyrethrum are banned from use. They kill the insects by poisoning them. Naphthalene, para dichloro benzene etc. kill the insects by suffocation.

Arsenic oxide, Durshban TC etc. eradicate termites completely. These chemicals may be dissolved in a suitable solvent either in kerosene or water and the drilled holes at a distance of about a foot along the joint between the floor and the walls may be filled with the insecticide solution and then covered with sand and finally with the flooring material. These chemicals are harmful to the users too. Therefore utmost care should be taken in handling them due to their poisonous nature. Dieldrin is also poisonous. In a volume of $1m^3$ only 0.25mg of

dieldrin should be present. This will kill silverfish. The use of dieldrin is not common. Now a days any chloro pyriphos chemical available in the market may be used for this purpose.

Silverfish and cockroaches may be eradicated by spraying Lindane (Hexa chloro cyclo hexanone) either in powder or solution form. This will damage ink. Therefore this may be sprayed or brushed where there is no writing.

Baygon (ortho isopropoxy phenyl methyl carbonate) may be sprayed in solution form (0.5%) in corners and cracks to eradicate cockroaches.

Pyrethrum is sprayed to eradicate cockroaches, silverfish etc.

Para dichloro benzene is a universal insecticide, which kills book lice, beetles by suffocation.

Drione has broad spectrum of insecticidal activity for the control of crawling insects like cockroaches, booklice, wasps, beetles etc. it can be dusted or sprayed.

Naphthalene kills beetles. If the archival materials are fumigated with naphthalene the beetles are killed.

Insecticides for rodents are two types. One variety of these insecticides kill the rodents by solidifying blood when they are eaten e.g. Warferin, kaumaberil. The other variety is one, which kills by forming a gas when the rodents eat the chemical. When the rodents eat zinc phosphide, phosphine gas is formed inside the intestine and they die.

Insect Traps:

It is better to find out the type of insects, which live in archives, libraries, museums etc., by suitable means and then treating them suitably. Insects are normally killed by using high voltage grid traps, by immersing them in liquids etc. But these methods cannot be used in archives etc. The insects, which come to archives, may be caught by installing a yellow prism like cardboard trap having applied adhesive in the upper portion

of the base. The insects, which are attracted by yellow colour, enter inside the prism and are caught stuck. By identifying the insects, suitable insecticides may be applied by suitable means in archives, libraries or museums and the insects can be eradicated.

Fungicides:

In moist condition fungi grow very easily on archival materials, which are organic in nature. Therefore archival materials should be treated with suitable fungicides. Thymol is a universal fungicide. If the fungal attacked archival materials are fumigated in a fume cupboard/chamber with thymol at about 52°C (20gms/m^3) for about a week the fungi are killed. The thymol dissolved in alcohol may also be sprayed in the stacks. A blotting paper dipped in 10% solution of ortho phenyl phenol and dried may be kept between the organic archival materials to get rid off fungi. The Central Leather Research Institute, Chennai did some research on fungicides and the material is being marketed in the name of *Nifol*.

A 0.5% solution of para nitro phenol in alcohol will drive away fungi. In order to get rid off fungi a spray of thymol-mercuric chloride mixture solution in ether-benzene mixed solvent may be given. A 0.5% solution of penta chloro phenol in water also may be used to remove fungal growth. Fungicides may be organic or in-organic chemical compounds.

Biocides:

Ethylene oxide and carbon-di-oxide mixed gas in the ratio 1:9 kills all types of biological agencies and thus archival materials are preserved. It is called as ethoxide and is being banned from use. *Vapona* is another chemical, which is being used for this purpose. DurshbanTC is a chloro pyriphos compound used to eradicate insects, termites etc.

Non-toxic Methods:

When the insecticide chemicals are used they stay over the archival materials and some side effects have been noticed both on the materials and human beings who handle them. Nowadays archival materials are exposed to low-nitrogen atmosphere for few hours to eradicate insects and fungi.

Cleaning of Archival Materials:

If the archival materials are found stained and got brown colour also with *foxing* marks they should be cleaned. Unless it is absolutely necessary archival materials should never be subjected to chemical cleaning.

Stain Removal:

Archival materials are organic in nature. Depending upon the ink, they should be cleaned using suitable solvents. The common solvents are water, acetone, alcohol, toluene, hexane, benzene, pyridine etc.

The oil, crease, wax etc., from the archival materials may be removed by using toluene, hexane, benzene, pyridine, petrol etc. A mixture of toluene and hexane is used to remove the gum from the cello-tapes. Fungal attacked paper may be cleaned with the help of hydrogen peroxide in alcohol. Lac and varnish are removed by acetone. A mixture of hydrogen peroxide and alcohol in equal quantities removes the stains made by flies and mosquitoes. Tea and coffee stains are removed by using 2% solution of potassium per borate in water. The stains due to iron based inks are removed by a saturated solution of sodium formaldehyde sulphoxylate in water. The stains due to iron gall inks are removed by 2% chloramine-T in water followed by 5% oxalic acid solution or 10% citric acid solution. The water stains are removed by immersing the document in water for 20 minutes followed by the immersion in hot water for 20 minutes. Eraser should remove superficial stains before the documents are

immersed in any chemical solution. The leaves should be numbered in pencil. The paste used in bookbinding should be removed by suitable means. The use of collaginase, an enzyme is used to soften glues. Therefore, much care should be taken to remove the pastes used without damaging the archival materials.

Bleaching Methods:

The dark brown colour, and foxing marks in documents containing water insoluble inks may be removed from the documents by the use of chemicals like chloramine-T dissolved in water (saturated solution).

Chloramine-T in alcohol may be used for water-soluble inks. This method does not allow the chemical to be contaminate the paper. Chloramine-T is a bleaching agent, which after the bleaching process gets evaporated and therefore no residual chemical is left behind. There is no need to wash the paper after the treatment. Chloramine-T solution should be prepared just prior to the treatment to have the maximum effect of the chemical. Old solution should not be used.

10% sodium hypochlorite in water may also be used as a bleaching agent. The document is kept on a polyester film/glass plate, moistened and dipped in the solution. It is taken out, washed in water and dipped in 2% solution of sodium thiosulphate and washed well in water to remove the adherent chemicals. Chlorine is removed by washing and the document gets a fresh cream colour.

Water stain, foxing marks, fungal growth etc., may also be removed by chlorine dioxide. 5% sodium chlorite is taken in a tray to the required amount and kept inside a fume cupboard. Then, formaldehyde to form a 2% solution is taken and poured into the solution. The wet document with proper support is dipped in the yellow solution, where chlorine-di-oxide formed, for a few seconds to a minute, taken out, washed in running

fresh water in a tray and naturally dried after thorough washing. This type of bleaching is better than sodium hypochlorite bleaching. If the immersion of the document is injurious to the document, the bleaching can be effected in the vapour phase also. This has been successfully carried out by the author and found successful.

Some important documents may contain the signatures of great leaders. If the document is stained a lot and the signature is to be preserved very well, the signature portion may be covered with a cellulose acetate foil using acetone. The document is bleached by any method described above. After the bleaching process, the cellulose acetate film may be removed by applying acetone. A particular portion of the document may also be protected with the help of 5% poly methyl methacrylate in acetone. The cellulose acetate may be removed after bleaching with the help of acetone. The soluble inks may be avoided from dissolution in this way.

Glazing of Paper:

The paper documents, which were chemically treated, will be free from earlier glazes and appear thin and weak. If glazed the paper will be strengthened. A 0.3% gelatine in water is prepared, the paper is dipped in it and the excess gelatine is squeezed out, dried and kept under two glass sheets keeping oil paper to avoid wrinkling.

Removal of Creases:

The creases in paper may be removed by moistening the creased area with cold or hot steam or damped cotton swab, silicon paper is kept over it, and pressed with hot iron. If creases are too many, then the record is put upside down, covered with a moistened blotting paper, pressed to remove the creases and kept under a glass plate. The creases are removed.

Pastes Used in Archives:

The choice of adhesives in archives and libraries are very important. If animal glues and plant resins are used, when dried they bent due to contraction of paper. Therefore, suitable pastes are used for archival use. Synthetic adhesives are avoided mostly. While preparing the pastes suitable insecticides are used.

1. Dextrin Paste:

The paste prepared out of 2.5kg dextrin, 40gms of clove oil, 80gms of barium carbonate, 40 gms of *saffron* red powder, dissolved in 5 litres of water is dextrin paste. In place of dextrin maida may be used.

2) Flour Paste:

Paste is prepared by dissolving 250gms of maida flour, 40gms of barium carbonate, 40gms of red powder in 5 litres of water.

The paste preparation is made as follows:

In a shallow vessel the water is brought to about the boiling stage. Dextrin or maida flour is added while stirring. Barium carbonate is also added while stirring the mixture. Then red powder and clove oil are added and heated for about 8 minutes.

Composition of Starch Paste:

Starch (Maida)	: 1 Part by weight
Formalin	: About 3% by weight of the starch
Glycerine	: About 2% starch by weight
Water	: About 4 parts by weight

Preparation of Starch (Maida) Paste:

Small amount of maida flour is mixed with sufficient amount of water in a copper or brass vessel and mixed well with out any lumps or nodules of flour. The mixture is then cooked

very carefully using a heater or fire till froth comes out. It should be seen that no charring of the maida paste takesplace. Glycerine is mixed at this stage with stirring. When the heat of the paste comes to the room temperature, formalin is added little by little and the paste is thoroughly stirred to have proper distribution of formalin.

Book binding paste was prepared by mixing 1 part of flour in 5 parts of water and 3% copper sulphate was then added. 2% glycerin was also added and paste was prepared by heating. Nowadays formalin is used instead of copper sulphate as copper sulphate accelerates acidification of paper.

In European countries the pastes prepared in the traditional way are used. After preparation the pastes are stored in special chambers for years together.

Restoration of Archival Materials:



Chiffon Lamination

Traditionally silk was pasted on both sides the records to protect them. But, silk is also an organic material therefore the record was not protected as thought off. Instead of silk chiffon cloth (synthetic polymer) is used in the lamination of documents. It is a reversible method. The chiffon pasted can be removed if required. But this method is being given up by many archives as the paste used is eaten by insects and the weak documents crumble and the legibility is low. But the Tamil Nadu Archives still continues this process.

Nowadays many materials are used in the lamination of documents. Cellulose acetate foil, tissue paper, chiffon cloth,

polypropylene, etc. are used in the lamination. There are many methods of lamination also.

1. Cellulose acetate foil is pasted to the document by applying heat and pressure.
2. The tissue paper is pasted to the document by dissolution of the cellulose acetate using acetone.
3. Plastic sheet also pasted on material by heat. But, it is not a good archival method. It is irreversible and is used for documentation work on commercial establishments. The Tamil Nadu Archives recently has resorted into this technique in laminating the books not the records.

Barrow invented a machine in which the document sandwiched with cellulose acetate foils and thin tissue papers on both the sides was inserted keeping it between silicone boards. Because of the heat and pressure, a good laminated document was got. In another method films having self-adhesives are used. Document sandwiched on both side with cellulose acetate foils and tissue papers may be laminated by dissolution using a cotton swab containing acetone and applying all over the tissue paper carefully. These methods are reversible as the tissue paper may be removed by soaking the document in acetone. In recent times carboxy methyl cellulose (CMC) paste is used for lamination work using tissue paper.

Leaf Casting:

Certain portions on paper sometimes found lost due to insect attack, brittleness, mishandling etc. There was a traditional practice of filling the holes with paper pulp. Following this method Alsale, an Israelite invented a machine called *The curator* to cast the lost portions of a document. This machine was subjected to certain improvements in Austria and finally got its full utility in Spain. This machine fumigates, de-acidifies and casts leaf at a time when the document is inserted.

Since, water is used in this method documents with water-soluble inks cannot be mended.

Encapsulation:

In the recent days the document after cleaning, bleaching etc., are put into polyester envelope and sealed using double sided adhesive tape. In this encapsulation method neither heat, pressure are exerted nor chemicals are used. Even by bending the document nothing happens to the document. The document is kept in position by the electrostatic charge of the polyester film.

Restoration of Inks:

Since the tannin in the iron gall ink disintegrates, the letters discolour. As only iron oxide is present in the letters they appear dull. If the iron in the letters is subjected to chemical change the letters may be restored. The discoloured letter is iron oxide. Potassium ferro-cyanide with little hydrochloric acid may be taken in a brush and applied very carefully on the letters. The document may be kept in between two sheets of glass for few minutes. Now blue letters are seen. This is due to the formation ferro ferric cyanide, which is deep blue in colour.

By the application of ammonium hydro sulphide solution the letters may be restored. But it is not so permanent as that of the earlier one. If a 2-3% solution of tannic acid is applied over the dull iron gall ink letters, they get back their black colour. Before the letters are restored the documents may be photographed in UV light and preserved. Anyhow care should be taken while chemicals are used to replenish the inks in the archival materials.

Restoration of Maps:

Maps are one of the items preserved in archives and libraries. Generally they are preserved in folded form. They break along the folds due to age and use. They cannot be

restored simply as that of the documents. Some special efforts should be made to restore them. The broken piece must be kept on a glass plate upside down. The torn portions are fixed using tissue paper bits using an adhesive. When dried, the map should be placed upside down on an oilpaper. Chiffon cloth slightly smaller than the map should be kept at the backside of the paper map and maida floor paste is applied. If necessary the map may be moistened by a swab before pasting. A squeeze roller may remove the excess paste. Then a brown paper strip is pasted at the edge of the map all around in such a way that a portion is on the map and the remaining portion is on the table. It is allowed to dry. During the drying process the wrinkles, creases etc., are set right. When dried the brown paper is cut, removed from the map. The map may be trimmed at the edge. We can get a smooth laminated map with out creases or wrinkles. This type of stretching is called brown paper stretching.

Conservation by Duplication:

Getting copies of the records is called duplication of records. From the middle of the 20th Century there has been a substantial inflow of modern synthetic information technology materials in the form of microfilm, microfiche, unitised jackets, audio-visual material and other computer out forms to the collection of archives. As is well known microfilming has been found to be a very good aid for obtaining copies of documents as well as exchange of information between different archival agencies world over. Xeroxing is another facility available to duplicate copies. Computer is now playing a very important role in the duplication of records and in these cases the information

Storage:

Storage is very important in the preservation of archival materials. It is not sufficient if proper environment is available to the building, but there should be proper arrangements for

storage and proper storage materials should be thought off and used. While the construction is made it is always better to consult the experts such as architects, engineers, conservation scientists etc., before the construction of the buildings for archives, libraries or museums.

1. The racks should be made of steel and painted and fixed away from the wall and at least 15 centimetres above the floor.
2. The racks should be adjustable and should facilitate the flow of air from one window to the other window at the other end.
3. The legs of the racks should have provision for trays to keep water or insecticides to avoid insect to reach the racks from the floor.
4. There should be provision to keep the records in the racks and remove them wherever necessary without difficulty.
5. There should be working space between the racks. There should be provision to vacuum clean the racks in the stack area or storage.
6. The wooden boards/perspex sheets used to bundle the records should be bigger than the records and tied properly tight.
7. Iron needles, pins, hooks should be removed from the records when kept in the racks.
8. The records should be kept vertically so that the indexed boards are visible. In case of big records/maps they may be kept one over the other interleaving between them in shallow drawers.
9. Smoking and open fire should not be allowed inside the stack room as they are dangerous to the archival materials.
10. Food materials should never be allowed inside the stack room as they attract the rodents.

11. Displaying a board explaining what should be done and what should not be done will help the staff to take much care.
12. Periodical dusting of the stacks should be done.
13. Periodical fumigation of the records should be made.
14. Affected storage materials should be changed whenever required.
15. The stack area or the storage should have an air control system to prolong the age of the documents and materials.
16. Proper training facilities should be provided to the staff in the latest archival principles followed.
17. Proper discussions should be arranged between the conservation chemists and archivists. Archivists should participate in the seminars relevant to the conservation of archival materials.

CHAPTER 6

STONE INSCRIPTIONS

History of Stone Inscriptions:

Stone inscriptions are the earliest records available through out the globe. As stone is a durable material this was chosen for recording the events of the past. Stone inscriptions are existing for quite long time. Besides this inscriptions on baked bricks and terracotta objects are also found. Stone tablets, terracotta objects, bricks etc., are preserved in the museums. The preservation of stone inscription is the duty of the conservators in the museum. But problem of preservation of the estampaged paper material is an archival one. The stone tablets might have been in a temple or in a forest. The inscribed matter is either photographed or copied in paper by the technique called *estampage*.



Technique of Copying:

Stone inscriptions are copied by a technique called *estampage*. The stone inscription is cleaned with water. Large sized white paper is made wet and placed over the face of the inscription and pressed well by striking with a bent brush. Paper gets into the groves of the inscribed letters. Some times two or three layers of paper might be required as the striking of the paper with brush may damage the paper and the torn paper might not serve the purpose. Then carbon ink is applied to a semicircular inkpad and the ink is transferred to the paper laid on the stone inscription by rolling. Except the portions, which are pressed into the grooves of the inscribed letters all the plain portions will take the ink. The inscribed

portions will appear white and the other portions will appear black. This paper with the inscription is to be preserved.

Preservation of the Estampaged Paper:

The estampaged paper is a very ordinary *map litho* paper, which is used in printing. They are prone to insect attack and microbial plant growth. High humidity, temperature, dust, acidity etc., will affect the estampaged paper. The conservation of the estampaged papers is similar to that of paper. The estampaged matter may also be photographed.

CHAPTER 7

DOCUMENTS ON TEXTILES

Historical Background:

Cloth is one of the materials on which man kept his records. Many *kalamkari* textile pieces in which writings are found are in the museums. There are cloths made out of natural fibres and synthetic fibres. In South India many *kalamkari* writings are preserved.

Kalamkari Paintings:

Kalamkari is an ancient craft of printing and painting textiles with vegetable dyes. It is another category of cloth painting. It is named so as the painting is done with pen (kalam = pen). The dye becomes the part of the fabric and does not superficially lie on the surface like paint.

Kalamkari textiles originated during the 17th Century in places like Masulipatnam and Kalahasti of Andhra Pradesh and later spread to other parts. They were used as canopies over idols during festival occasions and as panel on walls or as costumes. Temple cloths were made at centres such as Salem and Kumbakonam of Tamil Nadu in the early 20th Century, but the long representative of this tradition is confined today at Sickinaikkenpet, Tanjore district, Tamil Nadu. The samples made in the Masulipatnam area show that figurative *Kalamkari* are now being drawn free hand or in combination with block printing. These are called illustrated textile documents.

Degradation of Textiles:

Degradation on the textiles is brought about by the biological activity on the cloth, environmental factors such as humidity, light, heat, dust, and man made problems such as improper handling, improper storage, vandalism, etc.

Conservation Measures:

As far as the maintenance of the textiles is concerned they should be free from dust, acidic oxides, high relative humidity etc. The acidity on the textiles may be removed by dry-de-acidification or wet de-acidification. Ammonia vapour de-acidification is always better in this case. As far as the textiles are concerned it is always better not to use water for cleaning.

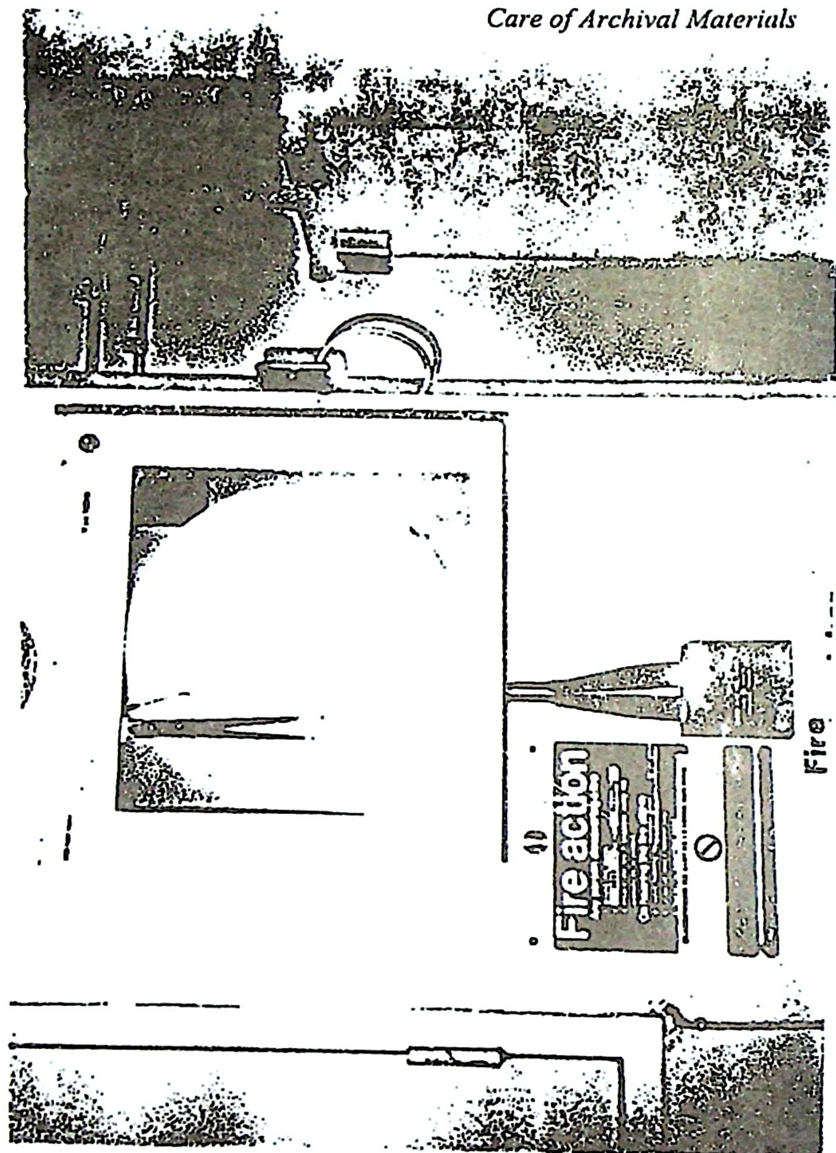
Mending of Textiles:

The textiles may be mended in many ways. One method is darning with similar thread. If the textile is very weak, then a support of similar material may be provided and stitched at points. The other method is to use similar cloth and pasting it to the original at the non-written side with the help of about 20% solution of poly vinyl acetate in acetone.

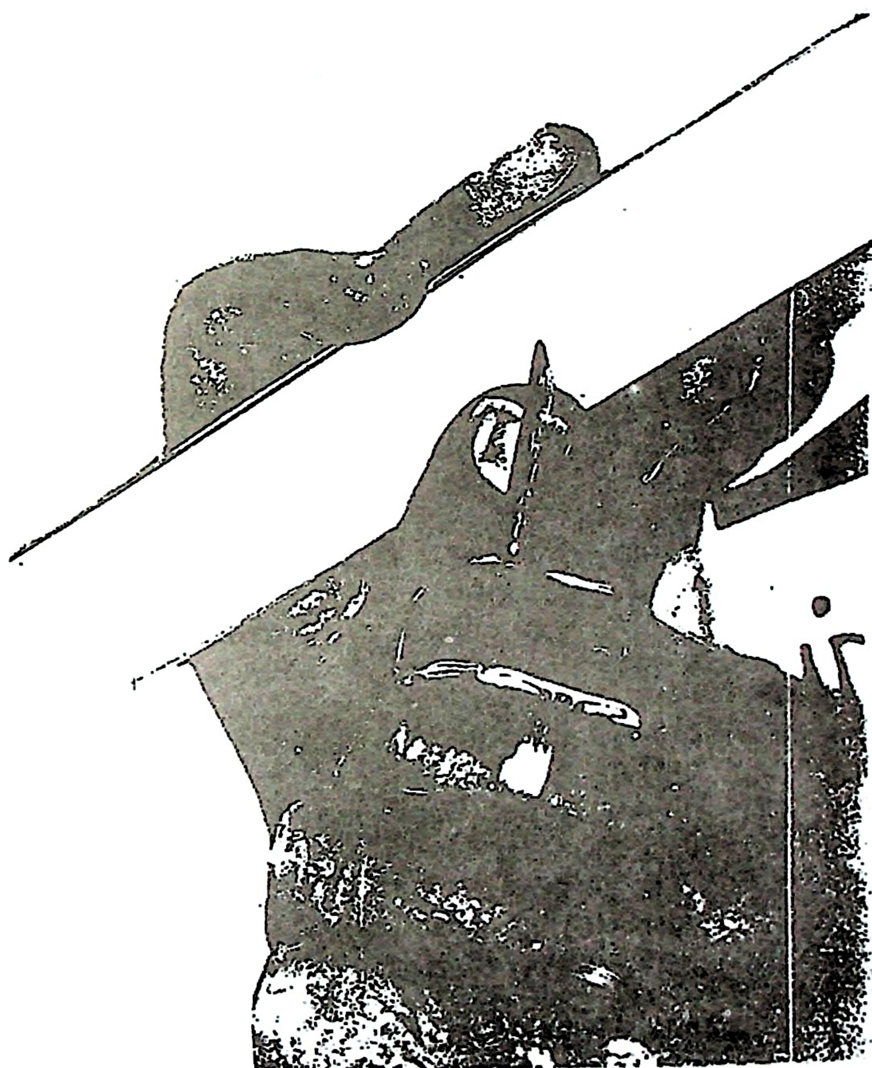
Storage of Textiles:

The storage of the conserved textiles poses another problem. The polymer tubes of larger diameter was chosen to roll the textiles on them. In the body, few holes can be made and the body may be covered with acid-free tissue paper. Inside the tubes, both para-di-chloro benzene and thymol can be kept in sachets and covered both sides with blocks of wood. The textile pieces may be then rolled over the tube interleaved with acid free tissue paper. The whole set up is then covered with polythene covers to avoid dust and moisture. It is always safer to provide only incandescent lamps, as tube lights will emit ultra violet radiation, which will decolourise the textile pieces. Care is taken to avoid natural light not to fall on the pieces. It is better to air-condition the storage through out the day, which will control most of the conservation problems. It is desirable to use non-toxic pest control in the stacking of an archives or the storage and galleries in the future. Freeze-drying at –20 to –30°C and

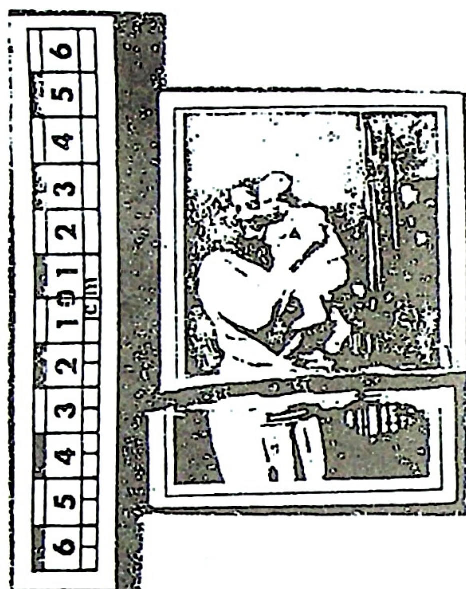
non-toxic pest control at low nitrogen atmosphere keep them well.



Electronic control for heat, humidity and fire in a storage room



Method of writing on palm leaf manuscripts



Conservation of photograph
Before and After



CHAPTER 8

PHOTOGRAPHS AND OTHER MODERN DOCUMENTS

Getting copies of the records is called duplication of records. From the middle of the 20th Century there has been a substantial inflow of modern synthetic information technology materials in the form of microfilm, microfiche, unitised jackets, audio-visual material and other computer out forms to the collection of archives. As is well known, microfilming has been found to be a very good aid for obtaining copies of documents as well as exchange of information between different archival agencies world over. The stability and durability of these modern archival materials with passage of time are still to be studied. But the laboratory evaluation and investigations have helped establishing their quality standards and deterring storage environment congenial to long life. The life of such materials starts from the quality of raw materials, preparing, processing, storage conditions, their inspection, methods of restoration etc. Almost all photographic materials, magnetic audio tapes and other allied computer out forms contain an active chemical suitably mounted on paper or film base. The active photo sound sensitive chemical gets modified with light or sound. Like the traditional records, these modern materials are also prone to suffer damage due to hot and humid climate.

Photographs:

There are different types of photographs in an archives or allied institutions. Mainly black and white photographs were used in the earlier days and many black and white photographs and negatives are being preserved. The black and white photographs are made in papers mounted with photosensitive chemical compounds such as silver halides.

In those days photographic negatives were prepared on glasses. Presently negatives are prepared on cellulose acetate films. The photographs are printed on photographic papers.

The glass negatives get damaged due to water, abrasion etc. The negatives should be held at the edges only. When stored, negatives should not touch each other.

The photographs, if found damaged, a fresh negative should be prepared. In the print the damaged portions should be reconstructed and another negative is prepared and preserved. Photographs should be framed with mounts and glass. If water falls on photographs it should be dried as such. Negatives should be put inside acid free paper covers and arranged inside cabinets and the temperature and humidity are controlled.

Diazaonium salts and other dye based coloured photographic materials are prone to fading and get disfigured due to storage at high temperatures and therefore need special storage care. One of the major causes of damage is the presence of dust and other atmospheric pollutants.

Microfilms:

Silver halide emulsion used for microfilms is hygroscopic and absorbs moisture. It becomes soft and expands when the relative humidity is high. Film base also absorbs moisture but to a lesser degree than the emulsion. This differential rate of expansion in the two important constituents results in damage. Further high humidity and temperature accelerate the growth of microorganisms and spots on films are quite a common phenomenon.

First generation microfilms are prepared from the original records. A copy is prepared. The master microfilm and copy are stored separately. From the negative only positives or copies may be made.

Air-conditioning of the storage area where photo archives, audio-visual materials etc., are kept is an essential need. If temperature of 14 ± 2°C and relative humidity of 35 ± 5% provides ideal storage environment. However, obtaining such lower limits of temperature in tropical climate where temperature gradient is much higher, increases the cost of operation of the air conditioning plant.

An important aspect which needs the attention for keeping these modern media is the storage containers used for keeping varied storage formats, while paper albums are for storing photo-prints and negatives of assorted sizes metallic, cardboard or plastic container are used for keeping microfilms.

Important guidelines are:

1. Acid free and lint free boards should be used.
2. Adhesive used should be of long-standing quality.
3. The containers should be of non-corrosive and non-staining materials.
4. It is necessary that positive and negative materials be kept separately.

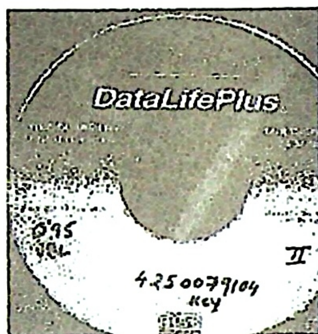


Floppy Disks:

Nowadays computer outputs are used in archives. The floppy disks should be stored properly.

1. Floppy disks should never be exposed to direct sunlight.
2. The relative humidity should be around 30%.
3. Since the floppy disks are magnetic in nature, telephone, X-ray equipment, motor generators should not be inside the storage.
4. The disks should not be bent.
5. They should be stored in separately indexed covers.
6. In case, there is no air-conditioned hall, silica gel may be used to absorb moisture where the records are very fragile.

CD-ROM:



CD-ROM stands for compact disk read only memory. This also comes in the form of Optical Disk. It can be used for storing audio, video or other software. This is portable. This gives the facility of storing huge volumes of data in a single disk. This disk can be used only to read or retrieve data. This cannot be used to write data once it is written. Recordable and re-recordable CDs are available now a days. The surface where the reading of the CD is done should be free from dust, grease and scratches. The surface should never be touched with hands. This is also necessary to store it within the CD case.

Hard Disks:

Hard disk is a storage system, which is necessary to a computer to work with. It is not portable. It should be free from strong magnetic fields. Viruses can affect this and there fore installing anti viral software in the hard disk should prevent it.

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